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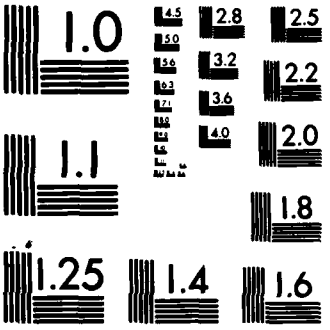

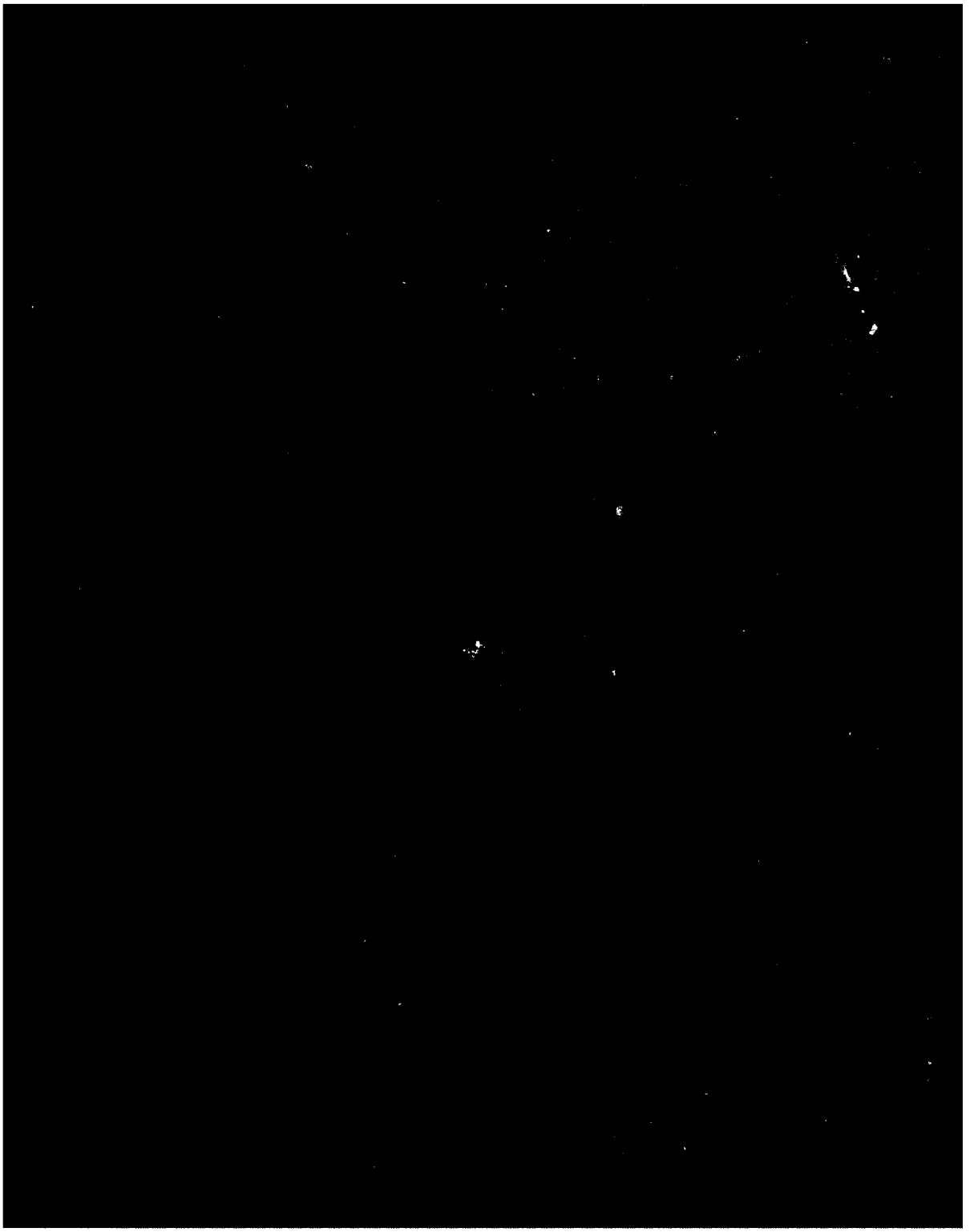

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This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and

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problems, to determine priorities for immediate and longrange action, and to identify the capabilities of various governmental units for implementing the actions.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

The Maple River Subbasin occupies 1,146 square miles of the southern North Dakota portion of the Red River Basin. It includes portions of Steele, Barnes, Cass, Ransom, and Richland counties and is bordered on the north by three subbasins: Goose, Elm, and Rush. Its western and southern borders are flanked by the sweeping curve of the Sheyenne River Subbasin.

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RECONNAISSANCE REPORT: RED RIVER OF THE NORTH BASIN, MAPLE RIVER SUBBASIN

Prepared for:

U.S. Army Corps of Engineers
St. Paul District
St. Paul, Minnesota

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I. STUDY AND REPORT

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This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North Study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential problems and solutions, to determine priorities for immediate and long-range action, and to identify the capabilities of various governmental units for implementing the actions.

The Maple River Subbasin is a water resource planning unit located in the southern North Dakota portion of the Red River Basin. This report describes the social, economic, and environmental resources of the subbasin, identifies the water-related problems, needs, and desires, and suggests measures for meeting the needs, particularly in the area of flood control.

The report was prepared almost entirely on the basis of secondary information. However, some telephone contacts were made to verify information and to acquire a more complete picture of local conditions. There are no comprehensive reports available on the subbasin, but published sources which were used include the following:

1. U.S. Department of the Interior, Correspondence to Colonel William Badger with attachments (1979), which discusses the effects of channelization on fish and wildlife and gives baseline data for fish and wildlife in the Maple River Subbasin. The attachments were published by the Environmental Services Section, U.S. Fish and Wildlife Service, Bismarck Area Office.
2. Application for Planning Assistance under the Watershed Protection and Flood Prevention Act, which was published by the State Soil Conservation Committee in 1954 and requests assistance in developing a work plan for the Lower Maple River Sub-watershed.

3. Flood Control Reconnaissance Report, South Branch of the Maple River at Enderlin, North Dakota, which was published by the St. Paul District Corps of Engineers in 1963 and discusses the possibility of Federal assistance in the alleviation of a flood problems at Enderlin, North Dakota.

4. Section 205, Flood Control Reconnaissance Report, Main Stem and South Branch of the Maple River at Enderlin, North Dakota, which was published by the St. Paul District Corps of Engineers in 1976 and discusses the feasibility of permanent local flood protection measures at Enderlin, North Dakota.

5. Application for Planning Assistance Under the Watershed Protection and Flood Prevention Act, which was published by the State Soil Conservation Committee in 1954 and is an application for planning assistance.

6. Watershed Work Plan for Watershed Protection and Flood Prevention, Swan-Buffalo Creek Watershed, Cass County, North Dakota, which was published by the Soil Conservation Service in 1969, and discusses the proposed five-year plan for the protection and development of the watershed.

In addition, the subbasin received partial coverage in the Souris-Red-Rainy River Basins Comprehensive Study, which was published by the Souris-Red-Rainy Basins Commission in 1972, and in the Red River of the North Basin Plan of Study, which was published by the St. Paul District Corps of Engineers in 1977.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

II. DESCRIPTION OF STUDY AREA

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The Maple River Subbasin (Figure I) occupies 1,146 square miles of the southern North Dakota portion of the Red River Basin. It includes portions of Steele, Barnes, Cass, Ransom, and Richland counties and is bordered on the north by three subbasins: Goose, Elm, and Rush. Its western and southern borders are flanked by the sweeping curve of the Sheyenne River Subbasin.

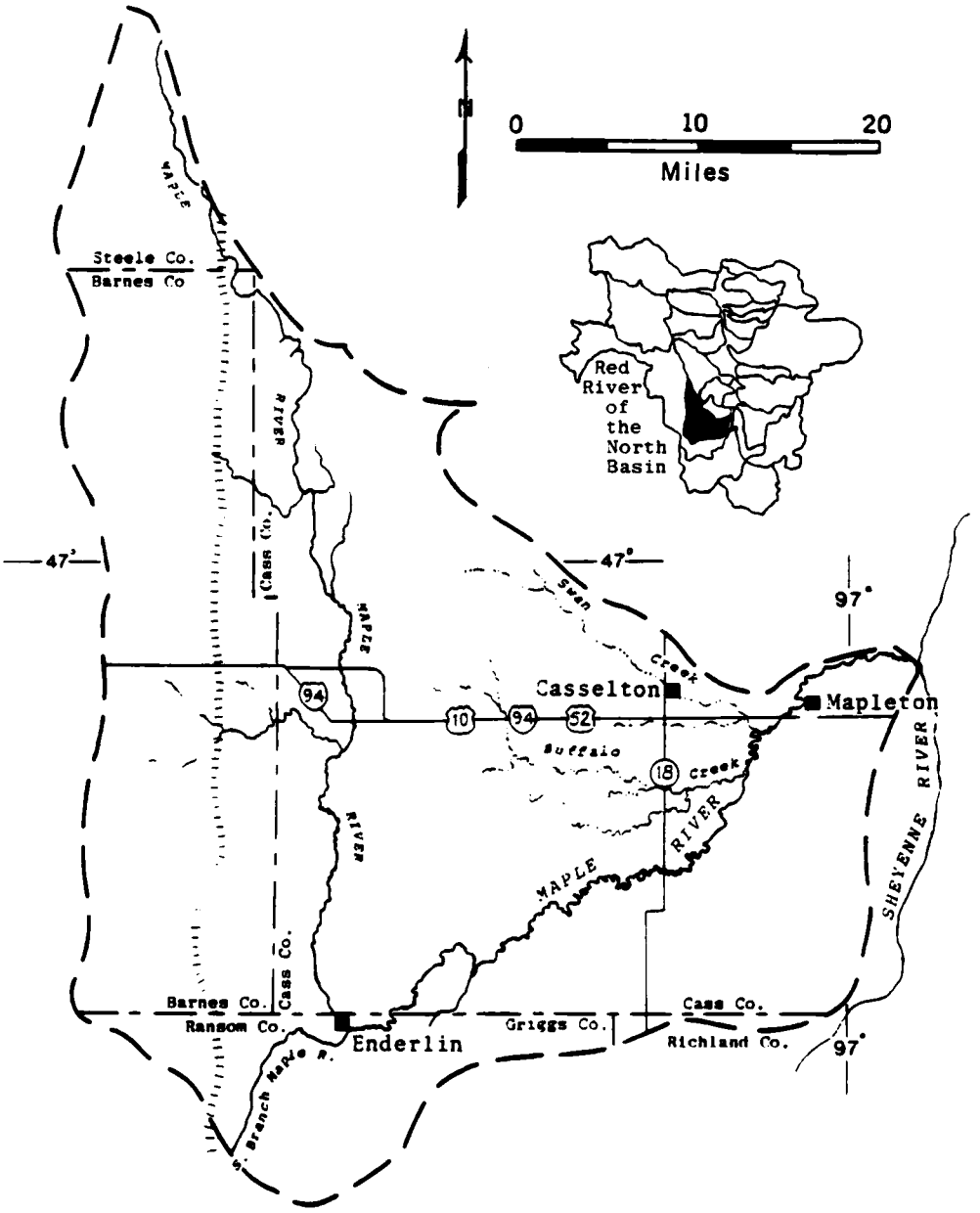
The Maple River originates in the upland areas of the five-county region which it drains. The river flows southward in a well-defined valley through the upland prairies north of Enderlin and across the Sheyenne Delta area between Enderlin and Chaffee, North Dakota. At Enderlin, the Maple River cuts sharply to the northeast across the flat, Red River Valley plain, where it meanders sluggishly before joining the Sheyenne River five miles south of West Fargo.

The western and northern portions of the subbasin are characterized by rolling uplands, which developed on a recessional moraine. Gradients here average up to 10 percent. Some soils are poorly drained in the prairie pothole region, which occurs in the western part of the subbasin.

Waterflows from the Maple River and tributaries east of Enderlin have a high velocity, but velocities decrease greatly in the plains area to the north and east of Leonard. Consequently, this region is subject to severe flood damage as channel capacities decrease. Much of the land affected is agricultural cropland, with gradients of only about one foot per mile. The upper Maple River contributes little if any to downstream flood damages.

The Maple River and the South Branch converge at the town of Enderlin, and thus, localized flood problems are compounded. Stream flow capacities at this point are reduced by meanders and blockages of the river channel with brush and trees. Flooding in the subbasin is characteristically caused from spring snowmelt runoff, often in combination with heavy spring rains.

The flat plains area north and east of Enderlin is seriously affected by limited channel capacities. As much as 21,000 acres of prime agricultural land have been inundated at one time in the plains region of the subbasin. Urban flood damages are also extensive in the flat plain area.



Source: Gulf South Research Institute.

Figure I. MAPLE RIVER SUBBASIN

III. PROBLEMS, NEEDS, AND DESIRES

III. PROBLEMS, NEEDS, AND DESIRES

The primary water-related problems, needs, and desires in the Red River Basin are flood control, fish and wildlife conservation and enhancement, recreation, water supply, water quality, erosion control, irrigation, wastewater management, and hydropower. Various water-related problems, needs, and desires have been identified for the Maple River Subbasin in previous planning reports on the basis of analysis of conditions and public and agency comments. The list of problems, needs, and desires for the subbasin is the same as the list for the Red River Basin as a whole, with the exception of hydropower. Each problem is discussed separately below, with an emphasis on flooding problems.

Flooding Problems

Nature of the Problems

Floods within the subbasin are almost an annual event. Most flooding conditions are brought about by spring snowmelt, sometimes combined with spring rains. Snowmelt floods usually occur in late March and April, causing delays in seeding crops which, given the short growing season in this area, results in a significant reduction in yields. Moreover, the abundance of small depressions, when wet, make it impractical to operate machinery on the irregular pattern of associated dry areas. As a consequence, even minor overflows usually impact large areas of the floodplain.

Flood damage also occurs from high-intensity summer storms, although they usually occur less frequently than spring snowmelt floods. High flows exceed channel capacities and cause damage to maturing crops. Many row crops are damaged from short periods of inundation, resulting in lower yields and poorer quality. Moreover, during some years harvest operations are delayed or even precluded.

Two separate types of flooding occur: the most damaging type associated with river bank overflow (overbank flooding) and another type caused by runoff from snowmelt or heavy rainfall impounded by plugged culverts and ditches within sections of land bounded by roadways on earthen fill (overland flooding). In overland flooding, the trapped water slowly

accumulates until it overflows the roadways and inundates section after section of land as it moves overland in the direction of the regional slope until reaching river or stream channels.

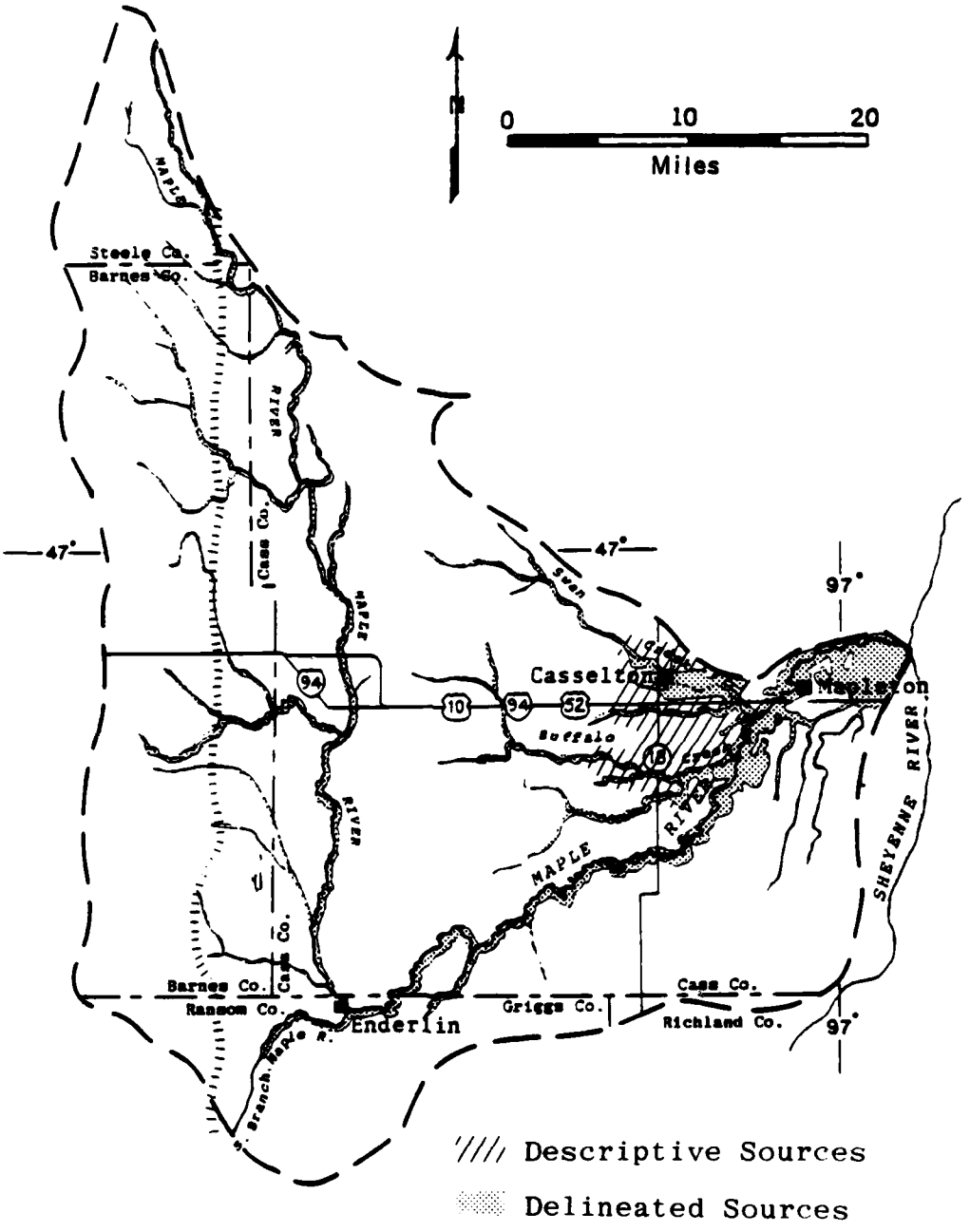
The topography of the subbasin, ranging from nearly level to undulating with intervening sloughs and depressions, also influences flooding problems. The upland drift prairie makes up the western two-thirds of the subbasin. Because its north-to-south course is very flat, the flow of the upper Maple is relatively slow. Most of the water along the lower reaches is drained off, with upper waters contributing little if any to downstream damages.

The beach ridge escarpment area of the upland prairie rapidly gives way to the flat plain of the Red River Valley. Water from the middle segment of the Maple and tributaries east of Enderlin is characterized by a fast concentration and high flow velocities. By the time waters reach the flat land area to the north and east of Leonard, velocities decrease steadily causing siltation and a lowering of stream capacity. Shallow channels and diminished gradients in this area cause floodwaters to overflow existing channels onto the surrounding lacustrine plain, damaging cropland, farmsteads, transportation facilities, and urban areas.

Location and Extent

Figure II depicts the 100-year floodplain for the Maple River Subbasin. Prior to this study, no attempt had been made to publish a generalized delineation of the entire subbasin. A number of sources were investigated in order to produce the present delineation. Among these were: (1) U.S. Geological Survey (USGS) Flood Prone Area Maps at 1:24,000 scale; (2) Corps of Engineers photomosaics of the 1979 flood; (3) published secondary sources describing flooded areas; and (4) USGS 7½ minute topographic maps.

The map is thus a composite of available sources supplemented by inferences where necessary. Because the sources were incomplete and based on surveys differing in purpose and accuracy, it should be understood that Figure II constitutes a generalized delineation intended only for general planning purposes. A more complete description of sources and limitations is given in Appendix A.



Source: Gulf South Research Institute.

Figure II. 100-YEAR FLOODPLAIN

According to this preliminary delineation, the Maple River 100-year floodplain comprises a total of 50,000 acres. Major components include: the Maple, 38,000 acres; Swan Creek, 8,000 acres; and Buffalo Creek, 4,000 acres. The floodplain of the upper Maple, terminating at Enderlin, accounts for 8,000 acres and is relatively uniform in width. The middle segment of the Maple River floodplain extends as far as the community of Durbin and varies from around a quarter mile to a half mile and greater. With the convergence of Buffalo and Swan Creeks, the lower Maple floodplain widens rapidly to several miles before merging with that of the Lower Branch Rush River and the Sheyenne.

Several secondary sources dating from the fifties indicate additional floodplain acreage in the Swan Creek-Buffalo Creek area. Thus, an additional 20,000 acres are shown in a cross hatch pattern in Figure II.

Flood Damages

The primary areas affected by flooding throughout the subbasin's floodplain are urban, agricultural, and environmental in nature. Enderlin and Mapleton are the only communities in the subbasin that are subject to recurrent flooding. Urban and rural damages are the only damage categories taken into account in the computation of average annual flood damages.

Present average annual flood damages in the subbasin are estimated at $596,500. This figure accounts for less than two percent of the Red River of the North basinwide average annual flood damage total. The two basic classifications into which average annual damages are divided are urban and rural. Damages to residences, businesses (commercial and industrial) and public facilities (streets, sewers, utilities, etc.) are reported as urban damages. Rural damages are damages to crops, other agricultural assets (fences, machinery, farm buildings, etc.), and transportation facilities. Rural damages account for 88 percent of total average annual damages in the subbasin, and urban damages account for the remaining 12 percent.

Urban flood damages sustained in the 1975 flood event totaled $631,300. This figure exceeded estimated average annual damages over eightfold.

Damages sustained in 1975 included $315,700 in residential damages, $252,500 in business damages, and $63,100 in public damages.

The 1979 flood event caused $111,000 in urban damages. This figure included $55,500 in residential damages, $44,400 in business damages, and $11,100 in public damages.

Average annual urban flood damages include $36,000 in residential damages, $28,800 in damages to businesses, and $7,200 in public damages. Total average annual urban flood damages are $72,000. Estimated average annual urban flood damages along with the damages incurred in the flood events of 1975 and 1979 are presented in Table 1.

Table 1

MAPLE RIVER SUBBASIN, ESTIMATED 1975, 1979 AND AVERAGE ANNUAL URBAN DAMAGES
(Thousands of 1979 Dollars)

Category	Year		Average Annual
	1975	1979	
Residential	$315.7	55.5	36.0
Business	252.5	44.4	28.8
Public	63.1	11.1	7.2
TOTAL	$631.3	$111.0	72.0

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Reports 1975, 1979; and Gulf South Research Institute.

Rural flood damages sustained in the flood events of 1975 and 1979 along with estimated average annual rural flood damages are presented in Table 2. The 1975 flood event devastated the rural areas of the subbasin, resulting in a total of $20.9 million in rural flood damages. This figure included $9.2 million in crop damages, $11.0 million in damages to other agricultural assets, and $690,000 in transportation damages. Rural flood damages incurred from the 1979 flood event totaled $1.5 million. This figure included $917,000 in crop damages, $236,000 in other agricultural damages, and $380,000 in transportation damages. Estimated average annual rural flood damages include $347,100 in crop damages, $115,700 in other

Table 2

MAPLE RIVER SUBBASIN, ESTIMATED 1975, 1979
AND AVERAGE ANNUAL RURAL DAMAGES
(Thousands of 1979 Dollars)

Category	Year		Average Annual
	1975	1979	
Crop	$ 9,231.1	$ 917.0	$347.1
Other Agricultural	11,026.2	236.0	115.7
Transportation	690.0	380.0	61.7
TOTAL	$20,947.3	$1,533.0	$524.5

Sources: Red River of the North Basin Plan of Study, April 1977; Post Flood Reports 1975, 1979; and Gulf South Research Institute.

agricultural damages, and $61,700 in transportation damages. Total average annual rural flood damages are estimated at $524,500.

Environmental Concerns

Most native woodlands, wetlands, and prairie have been converted to agricultural land and other land uses. Cropland accounts for about 86.2 percent (632,225 acres) of the total subbasin area of 733,440 acres. Forest, the principal wildlife habitat type, comprises only about 0.3 percent or 2,200 acres. Woodlands are confined mainly to the floodplain along the Maple River and its tributaries and occur in planted shelterbelts and windbreaks in the farmlands. Intensive farming has resulted in the drainage of moist wetlands in the Red River Valley and extensive drainage of those found in the drift prairie. Most native prairie communities have been eliminated or altered through agricultural development or utilization by livestock. Limited remnants are likely to occur in scattered areas such as in the natural areas of the subbasin, which will be described later (U.S. Fish and Wildlife Service, 1978, 1979). There is a definite need to protect, conserve, and enhance these three habitat types since they are of limited extent and because they are the three major habitats for wildlife in the subbasin.

Streamflows in the Maple River and its tributaries are generally inadequate from late summer through winter to meet minimum requirements for fish, wildlife, and recreational use. Annual discharge records for the river indicate flows have varied from 0-7,000 cfs, with an average flow of 63.4 cfs. The intermittent streamflows and high levels of pollution have substantially limited the fishery of the Maple River. Most fish species present are the result of upstream movement from the Sheyenne and Red Rivers during spring runoff. Water quality degradation, results, at least in part, from high levels of nitrates, orthophosphates, and metaphosphates originating from feedlots and heavily eroded fields. It has also been mentioned that Casselton Reservoir, a small impoundment managed by the North Dakota Game and Fish Department, is considered marginal for sport fishing (Upper Mississippi River Basin Commission, 1977; U.S. Fish and Wildlife Service, 1978). The water quality of the Maple River needs to be improved for the benefit of both aquatic organisms and wildlife. Provision of more continuous, dependable flows would also create more favorable conditions for biota. Although it was not indicated what the *limiting factors* were in Casselton Reservoir, they are probably the result of shallow depths, a chronic problem in many of the impoundments on the tributaries to the Red River.

Recreation Problems

Recreation problems in the subbasin stem from the lack of large bodies of water and forest tracts with high recreational value or potential. The level plain that comprises most of the subbasin is not suitable for the construction of artificial reservoirs which could be used for recreation and flood control.

Hunting is limited to the waterfowl production areas in the extreme western portion of the subbasin and two wildlife management areas near Casselton.

Fishery resources in the subbasin are limited by intermittent flows, especially during the summer months when recreational activity is at peak level. In addition, pollution caused by agricultural and feedlot runoff has added to the problem of maintaining a productive fishery resource.

The agricultural practices of wetland drainage, clearing of timberland, and heavy use of fertilizers have contributed to the lack of recreational opportunities in the subbasin. Residents of the area must travel outside the subbasin to fulfill water-based and related recreational needs.

Water Quality Problems

Insufficient streamflows during the late summer and winter months reduce the river's oxygen content, which results in decreases in fish populations and other aquatic communities. Feedlot runoff, seepage from septic tanks, and municipal effluents further reduce these dissolved oxygen levels. Surface waters in this subbasin are normally characterized by TDS levels in excess of 500 mg/l (Upper Mississippi River Basin Commission, 1977). Boron and sulfate levels also exceed acceptable standards at times (U.S. Geological Survey, 1979).

The Upper Mississippi River Basin Commission (1977) stated that the groundwater supplies in the subbasin contained excessive concentrations of TDS and iron. Hardness appears to be a problem in the area, also.

Water Supply Problems

There are few water supply problems within the subbasin, although many of the towns and farmers rely on rural water systems. Rural farms near Enderlin and the city of Casselton use transported water from Leonard. The community of Enderlin uses its own ground well water, but it is extremely hard and must be treated with lime for domestic purposes. Local public officials report no anticipated problems with their water supply.

Erosion Problems

Wind erosion is prevalent over most of the subbasin. Cultivated fields on sandy soils and land without cover is especially susceptible to wind erosion. In the glacial till upland and near the beachlines where the slopes are steepest, sheet and gully erosion occurs. This sometimes causes drainage fills and, in some cases, covering of crops. Damages from floodplain scour and streambank erosion are negligible due to low stream gradients and the low velocities of the floodwater as it leaves the channel and spreads across the land.

Irrigation

The subbasin is located within North Dakota's Planning Region V. At the present time, very limited amounts of acreage in the region are being irrigated. Irrigation is limited within the region and the subbasin because of the lack of adequate water supplies and the poor water quality.

If irrigation is to be developed in the subbasin, the water quality must be improved, and existing aquifers will have to be fully investigated.

Wastewater Management

The Upper Mississippi River Basin Commission (1977) reported high fecal coliform counts and a fecal coliform/fecal streptococcal ratio that indicates a mixture of human and animal waste contamination. These pollutants are the result of feedlot runoff, seepage from inadequate septic drain fields, and municipal sewage discharges. Table 3 presents the waste treatment facilities and needs of ten communities within the subbasin. The data indicate that most of these communities are operating near or exceeding the design capacity of their treatment facilities.

Hydropower

There are no hydroelectric facilities located within the subbasin, and future development is not planned at this time. The flat topography of the subbasin is not conducive to the construction of reservoirs large enough to hold water supplies adequate for hydroelectric facilities. Most of the future hydropower development in the area of the basin is expected to occur in the Minneapolis-St. Paul area, which is located southeast of the basin.

Public Perception of Problems and Solutions

The public's perception of problems and solutions in the subbasin is difficult to define. The primary documents for determining public perceptions are applications for study of the area made in 1954 and 1955. The local sponsoring organizations stated the desire that all components of the watershed be planned concurrently in order to provide necessary improvements in the most economical manner. The application for the

Table 3

WASTE TREATMENT FACILITIES AND NEEDS FOR TEN COMMUNITIES WITHIN THE MAPLE RIVER SUBBASIN

Community	Population Served	Design Flow (MGD)	Actual Flow (MGD)	Type Treatment	Surface Area (Total Acres)	Needs or Comments
Buffalo	241	0.019	0.016	Secondary	2.94	Construct 1.0 acre lagoon
Casselton	1,485	0.145	0.097	Secondary	23.3	Construct 2.0 acre lagoon
Davenport	147	0.011	0.010	Secondary	1.74	Construct 0.7 acre lagoon
Enderlin	1,343	0.086	0.087	Secondary	11.6	Inadequate
Fingal	166	0.020	0.011	Secondary	3.12	--
Leonard	221	0.019	0.014	Secondary	2.58	--
Mapleton	219	0.025	0.014	Secondary	3.90	Construct 1.6 acre lagoon
Oriska	128	0.012	0.008	Secondary	1.8	--
Sheldon	192	N/A	0.012	Primary	Private Septic Tanks	Lagoon being constructed
Tower City	289	0.028	0.018	Secondary	3.82	Divide and reline existing primary cell

Sources: Shewman and North Dakota State Department of Health, no date; North Dakota Statewide 208 Water Quality Management Plan, 1978.

Swan/Buffalo watershed indicates that individual businessmen and farmers supported the watershed approach toward solving flood problems.

Additional evidence for interest in flood control measures is contained in public hearings held in East Grand Forks in 1978 and 1979 before subcommittees of the Committee on Public Works and Transportation of the U.S. House of Representatives. From these documents, it is evident that most residents of the Red River Basin consider flood control to be the primary water related need for the area and that they are interested in whatever solutions may be proposed by Federal, state, or local agencies.

IV. DESCRIPTION OF SUBBASIN RESOURCES

IV. DESCRIPTION OF SUBBASIN RESOURCES

This section of the report discusses the primary resource conditions within the subbasin that are water-related and that would be affected by a comprehensive water and related land resources plan centering on flood control measures.

Social Characteristics

For several decades, the farm population of the subbasin has been decreasing, and the urban population has been increasing. This has happened because mechanization has replaced a large number of farm laborers and many farms have been consolidated. As a result, a large portion of the unemployed rural population has moved to the urban areas in search of better economic conditions. In spite of the declining rural population, the subbasin has experienced an increase in total population over the past few decades. Between 1970 and 1977, the subbasin's population increased from 12,345 to 12,859, which was a 4.2 percent increase. The rural to urban shift is apparent within the counties in the subbasin. Barnes and Steele, the most rural counties, lost population due to a large amount of outmigration. The outmigration rate for Barnes was 7.9 percent, and Steele's outmigration rate was 6.7 percent. Ransom County experienced a slight increase due solely to inmigration (0.6 percent). Both Cass and Richland counties increased during the 1970's. Cass County has the urban center of Fargo, and Richland County contains the city of Wahpeton. Each of the counties had a natural increase (more births than deaths), but their increases in population were mainly the result of inmigration. Cass County's inmigration rate was six percent, and Richland County had an inmigration rate of 2.5 percent. The population density of the subbasin increased from 10.8 persons per square mile in 1970 to 11.2 persons per square mile in 1977.

The subbasin has no large cities. The largest towns are Casselton, whose population is 1,645, and Enderlin, which has a population of 1,224. Although Casselton's population increased by 10.8 percent between 1970 and 1977, Enderlin's population decreased by almost nine percent. None of the other towns in the subbasin have populations over 300.

The largest ethnic group represented in the subbasin is Scandinavian, and over one-third of the Barnes, Cass, Steele, and Ransom county populations are of Norwegian descent. Thirty-six percent of the Richland County residents are of German ancestry. The minority population is too small to be identified.

Communities appear stable on the basis of home ownership, length and county of residence, and county of employment. Most people own their homes, ranging from 67.6 percent in Barnes County to 76.4 percent in Ransom County. The 1970 statistics indicate that 58 percent of the Barnes County and 70 percent of the Ransom County population occupied the same residence in 1965; the range of those living in the same county was from 79 percent in Richland to 85 percent in Steele County. Cass County figures are lower than the other counties in the subbasin, with 59.3 percent owning homes, and 48 percent occupying the same residence as in 1965, but with 70 percent living in the same county. The inclusion of Fargo in the county statistics distorts the basic rural stability of the subbasin. Most of the subbasin's population works in the county of residence, ranging from 82 percent in Richland County to 87.4 percent in Cass County.

Economic Characteristics

Employment

The agricultural sector is the most important employment sector in the subbasin. In most of the counties within the subbasin, farm employment amounts to more than 30 percent of the total employment. Cass County is the exception because it contains the urban center of Fargo, where 89 percent of the labor force works. Agricultural employment has decreased over the past two decades in the subbasin, but moderate increases in other sectors, primarily in Cass County, have compensated for the decrease. As a result, there has been a small increase in total employment during the last two decades. The decrease in farm employment has been the result of increased mechanization and farm consolidation. The total number of farms has decreased, while the average size of farms has increased. Between 1970 and 1977, these trends have slowed, and other sectors have continued to increase. During the 1970's, there was an increase in total employment from 4,197 in 1970 to 6,172 in 1977--an increase of 47 percent.

Unemployment in the subbasin averaged about 5.5 percent during the 1970's. Employment is high during the spring, summer and fall while the crops are being planted and harvested. During the winter, agricultural activities decrease drastically.

Income

Total personal income for the subbasin increased from $79 million to $104 million between 1969 and 1977 (as expressed in 1979 dollars). Farm income accounts for more than 60 percent of the total personal income, and cash grain sales and livestock production amount to 59 percent and 27 percent, respectively, of the total farm income. Average per capita income during the same years increased from $6,389 to $8,060, which was 15 percent above the 1979 average income figure of $6,859 for the whole state.

Business and Industrial Activity

Agriculture

Agriculture is the most important factor in the subbasin's economy, and small grains are the most important agricultural component. Approximately 86 percent (or 630,758 acres) of the subbasin's land area is under cultivation, and another 6.6 percent is devoted to pasture.

The major crops grown in the subbasin are identified in Table 4. Wheat is the leading crop, accounting for about 36 percent of the harvested acreage. This is followed by sunflowers, barley, hay, soybeans, corn, and oats, which collectively amount to 62 percent of the harvested acreage. There are also minor acreages of sugarbeets, flax, and rye. Sunflower production has become increasingly important in the subbasin and the state as a whole during the 1970's and presently accounts for 22 percent of the harvested acreage in the subbasin.

The eastern part of the subbasin contains the richest soil and is classified as prime farmland. Most of the area is devoted to growing small grains, sunflowers, soybeans, and sugarbeets. In the western part of the subbasin, small grains, sunflowers, and corn are important crops.

Table 4

1978 CROP STATISTICS, MAPLE RIVER SUBBASIN

Crop	Harvested Acres	Yield Per Acre	Total Production
Wheat	269,530	31.2 bushels	8,409,336
Sunflowers	169,280	1,450 pounds	245,456,000
Barley	152,850	48.2 bushels	7,367,370

Source: Gulf South Research Institute.

Livestock production is important in the subbasin. The counties within the subbasin were leading producers of hogs in 1978. Cattle production was more prevalent in the western and southern portions of the subbasin.

Cropping patterns within the floodplain of the subbasin are similar to those throughout the subbasin, with greater emphasis on specialty crops. Small grains, sunflowers, and corn are crops commonly grown in the floodplain.

Manufacturing

About half of the 36 manufacturing establishments in the subbasin are involved directly or indirectly with the agriculture industry. There are six fertilizer plants, nine plants which process grain, beans, honey, sunflowers, and molasses, and several shops which make or repair farm implements. Manufacturing employment amounts to six percent of the total subbasin employment. The manufacturing establishments are listed in Table 5 according to their Standard Industrial Code (SIC).

Trade

In 1977, total trade receipts for the subbasin exceeded $224 million (expressed in 1979 dollars). Nearly 80 percent (or $177.5 million) of the receipts were wholesale trade. Retail trade and selected service receipts were $47.0 million and $5.3 million, respectively, in 1977.

Table 5

MANUFACTURING ESTABLISHMENTS, MAPLE RIVER SUBBASIN

SIC	Description	Estimated Employment
02	Agricultural Production-Livestock	9
14	Mining of Nonmetallic Minerals	9
17	Construction-Special Trade Contractors	50
20	Food and Kindred Products	32
24	Lumber and Wood Products	9
27	Printing and Publishing	30
30	Rubber and Plastics Products	9
35	Machinery, except Electrical	18
37	Transportation Equipment	9
39	Miscellaneous Manufacturing Industries	18
42	Motor Freight Transportation/Warehousing	18
51	Wholesale Trade-Nondurable Goods	85
52	Building Materials and Mobile Home Dealers	9
54	Food Stores	18
72	Personal Services	9
76	Miscellaneous Repair Services	18
TOTAL		350

Source: 1978-1979 Directory of North Dakota Manufacturing.

Transportation Network

Since this subbasin is dependent on agriculture, a good transportation system is necessary to move products to the distribution centers and also to receive goods and services. The city of Fargo is near the subbasin, located at the junction of Interstate Highways 94 and 29. The major north to south highways in the subbasin include State Highways 32 (near Luverne, Nome, Fingal, and Pillsbury), 38 (near Ayr and Buffalo), and 18, which runs through Casselton. All of these highways intersect I-94 and provide the subbasin with fast, efficient access to Fargo. Residents in the southern part of the subbasin can use any of the north to south routes to reach I-94, and they can travel State Highway 46 east to I-29, which runs north to Fargo.

The Soo Line Railroad has one line which crosses the subbasin at Enderlin. The Burlington Northern Railroad has several lines which cross the subbasin and travel to the city of Fargo. Most of the rail lines cross the Maple River and may be subject to flooding, as are highways 46 and 18 and some of the county roads. There are small airports at Leonard and Enderlin for public use, but the available facilities are very limited.

Land Use

Approximately 86 percent of the subbasin is under cultivation, 6.6 percent is pasture, and 4.5 percent is urban development. Water areas amount to about one percent of the total land area and are located primarily in the southwestern part of the subbasin. Forest areas amount to less than one percent of the total land area, and they are found mainly along the river. Land use in the floodplain is very similar to land use in the remainder of the subbasin. Most of the land in the floodplain is under cultivation, and the only town in the floodplain is Enderlin; Mapleton is located at least partially in the floodplain.

Environmental Characteristics

Climate

Mean monthly temperatures in the Maple River Subbasin range from 66.6°F in the summer to 5.0°F in the winter. The extreme recorded temperatures range from -43°F to 115°F. A normal frost-free period is usually 128 days, with the average date of the first killing frost on September 22, and that of the last killing frost on May 17. The mean annual precipitation at Amenia, just outside the subbasin, is 18.88 inches, and the mean annual snowfall is 29 inches. Damage occurs each spring when there is a fast snow melt, usually during the months of April and May. The damage is caused by delayed seeding, which can seriously lower production as the growing season is short. Excessive rainstorms causing damaging floods occur during the months of June, July, and August.

Geology

The subbasin lies within the Western Lake Section of the Central Lowland Province in the Interior Plains physiographic division. Shale and limestone, which form the Cretaceous Colorado Group, and undifferentiated

deposits of the Dakota Group overlie Precambrian igneous and metamorphic rock. The western portion of the subbasin is characterized by rolling plains broken by low ridges of hills and sloughs. The eastern portion of the subbasin is almost flat, level land which is the lake bed of former glacial Lake Agassiz. Glacial deposits include till and outwash areas in the west and clay and silt lake deposits in the eastern portion of the subbasin. There is a small section of delta sand and gravel lakeshore deposits in the southern portion of the subbasin. These deposits have weathered to produce the fertile agricultural soils characteristic of the area.

Biology

The original vegetation of the subbasin consisted of the Northern Floodplain Forest, Tall Grass Prairie, and Transition Prairie. Agricultural development in the form of cropland and pastureland, and other land uses have eliminated, altered, or limited most of these native communities. Woodlands occur in the middle and lower portions of the Maple River floodplain and along the Red River, where they comprise 0.3 percent, or 2,200 acres, of the 733,440-acre total subbasin area. The forest is relatively well developed in the Maple River floodplain, and would be composed of the following types: Elm-Basswood community and Green ash-Boxelder community. The Elm-Basswood community is generally found adjacent to the stream where moist soil conditions exist. In addition to the two dominants, cottonwood, willows, hackberry, and hophornbeam or ironwood are common trees. The Green ash-Boxelder community is found further away from the stream edge and also on mesic slopes. Associated tree species include willow, hackberry, cottonwood, American elm, basswood, and burr oak in drier situations. The shrub and herbaceous layers are generally better developed in this community than in the Elm-Basswood type (Seiler, 1973; U.S. Fish and Wildlife Service, 1978).

The Tall Grass Prairie was generally found in the Red River Valley portion of the subbasin in eastern Cass County. Nearly all of the prairie has been converted to tilled farmland. Some characteristic plants may still persist in the pasturelands, which constitute 6.6 percent, or 48,408 acres, of the total subbasin area. The dominant species in this

community are big bluestem, switchgrass, Indian grass, and prairie dropseed. Midgrasses, sedges, and forbs are also abundant. The Transition Prairie occupies the drift prairie or western portion of the subbasin, where it forms a transition between the Tall Grass Prairie to the east and the Mixed Grass Prairie to the west. Dominants include prairie June grass, green needlegrass, needle-and-thread, blue grasses, little bluestem, and yellow sedge. Numerous other grasses and forbs are also present. Agricultural development has eliminated or altered much of this community (Kuchler, 1964; Stewart, 1975; U.S. Fish and Wildlife Service, 1978).

The great majority of the wetlands in the Red River Valley section of the subbasin have been drained and converted to farmland. Most of the wetlands that occurred in the prairie drift or Prairie Pothole region have also been eliminated or adversly affected by drainage activities. Within the counties included by the subbasin's boundaries, four types of wetlands were found as of 1964: Type 1--seasonally flooded basins and flats; Type 3--shallow fresh marshes; Type 4--deep fresh marshes; and Type 5--open fresh water (U.S. Fish and Wildlife Service, 1978, 1979).

The important wildlife habitats of the subbasin include the existing woodlands, wetlands, and grasslands. The woodlands and brushy areas provide travel routes, den and nesting sites, territories, winter and escape cover, and winter food for much of the wildlife of the prairie region. Some small mammals are restricted almost solely to this habitat, and the larger ones will use them extensively for cover or as browse. Forests afford breeding and nesting areas for birds and rank second only to wetlands in breeding bird population densities. They contain a greater variety of wildlife species than any other major habitat type. Wetlands furnish spawning and nursery areas for aquatic vertebrates and breeding and rearing habitat for big and small game, furbearers, and other wildlife such as wading and passerine birds, and provide a high-yield food source for many resident species. The native grassland is one of the most spectacular biotic communities in North America, supporting diverse and abundant populations of birds, mammals, and invertebrates. In combination with wetland complexes, it forms

a dynamic and diverse ecosystem (U.S. Fish and Wildlife Service, 1979, 1980). These three region habitat types need to be protected, conserved, and enhanced where possible because of their value to the wildlife resources of the subbasin.

White-tailed deer, the major big-game animal, are generally present in low densities (<0.5 deer/square mile) in the subbasin, except along the Red River where high populations (>1.5 deer/square mile) are found. Small game mammals consist of squirrels and the cottontail. In the Red River Valley, waterfowl population densities are low at <4.0 breeding pairs/square mile, while the drift plain or Prairie Pothole Region in the west supports moderate densities with 4.0-9.0 breeding pairs/square mile. The most common breeding waterfowl are the mallard, blue-winged teal, pintail, gadwall, and northern shoveler. The woodlands along the Maple River are known to be important for wood duck production. (Data from the North Dakota Game and Fish Department in U.S. Fish and Wildlife Service, 1979; U.S. Fish and Wildlife Service, 1978).

The pheasant and Hungarian partridge are the principal upland game birds. Pheasant population densities are high (>10.0 hens/square mile) in the southern portion of the subbasin and moderate (1.0-10.0 hens/square mile) in the upper portion; partridge populations are considered low throughout the region with <12 birds/1,000 miles of rural mail carrier route. The sharp-tailed grouse is also hunted, but population densities are generally low at <3.0 sharptails/square mile. Common furbearers are the red fox, beaver, muskrat, mink, raccoon, and skunk. In the Red River Valley, red fox densities are moderately low with 5.0-8.9 families/township and moderately high in the drift prairie area with 9.0-13.0 families/township. Table 6 gives harvest data for Cass County from 1970-1975 for many of the species mentioned above. (Data from the North Dakota Game and Fish Department in U.S. Fish and Wildlife Service, 1979).

Approximately seven species of amphibians and eight species of reptiles may occur in the subbasin. Typical herpetofauna include the tiger salamander, Great Plains toad, and the red-sided garter snake. A total of 262 species of birds have been reported from the Sheyenne River Basin, which lies to the immediate south and west of the Maple River Subbasin. Most, but not necessarily all of these avians will occur in the Maple River area as residents or immigrants. Characteristic breeding birds

Table 6

HARVEST DATA FOR GAME AND FURBEARING ANIMALS IN CASS COUNTY, 1970-1975, MAPLE RIVER SUBBASIN

Species	Number Harvested					
	1970	1971	1972	1973	1974	1975
Red fox (trapped and hunted)	159	1,014	885	2,343	1,096	1,356
Coyote (trapped and hunted)	-0-	-0-	-0-	-0-	-0-	2
Sharp-tailed grouse	172	312	57	95	-0-	48
Ring-necked pheasant	493	893	1,252	1,278	992	727
Cottontail	2,719	2,426	2,532	8,079	2,177	1,712
White-tailed deer	200	562	458	628	404	417
Hungarian partridge	794	1,018	1,831	3,050	3,147	1,390
Fox squirrel	3,412	3,434	3,260	5,290	3,588	1,659

Source: North Dakota Game and Fish Department in U.S. Fish and Wildlife Service, 1979.

of the different habitats in the subbasin include the western meadowlark in croplands, Savannah sparrow in pasturelands, western kingbird in shelterbelts, short-billed marsh wren in wetlands, and white-breasted nuthatch in forests. Fifty-six species of mammals have also been accounted for in the Sheyenne River Basin; most of these will occur in the Maple River Subbasin. Common or fairly common nongame mammals consist of the short-tailed shrew, silver-haired bat, Richardson's ground squirrel, northern pocket gopher, and meadow vole (Stewart, 1975; U.S. Fish and Wildlife Service, 1978; Wiehe and Cassel, 1977).

The Maple River drains an area of approximately 1,450 square miles, most of which is located within Cass County. Portions of the Maple River and many of its tributaries have been channelized, resulting in a degradation of water quality. Additionally, feedlot and agricultural run-off have contributed to this pollution problem. The channelization has also caused some problems by creating intermittent flows during the summer periods. No impoundments have been constructed on the Maple River, although four small impoundments have been constructed on two of the major tributaries. Only one of these four, Casselton Reservoir is presently being stocked and managed by the North Dakota Game and Fish Department (U.S. Fish and Wildlife Service, 1978).

The U.S. Fish and Wildlife Service and North Dakota Game and Fish Department (1978) have classified the Maple River as a Class III stream with a substantial fishery resource. The pollution sources discussed in the preceeding paragraph have helped to reduce this stream's value. The river supports a moderate forage fish production and moderate sport fishery of northern pike, blue gill, and bullheads (U.S. Fish and Wildlife Service and North Dakota Game and Fish Department, 1978). Most of this sport fishery is created by upstream movements from the Sheyenne and Red Rivers during the spring floods (U.S. Fish and Wildlife Service, 1978). Copes and Tubb (1966) found that the most commonly occurring game fishes of the Maple River were northern pike, channel catfish, and crappie. Fathead minnows, carp, common shiners, creek chubs, common white suckers, brook sticklebacks, and Johnny darters comprised the common rough and forage fishes.

Aquatic plants that have been reported (U.S. Fish and Wildlife Service, 1978) from the small ponds and lakes within the subbasin include slender bulrush, cattail, hardstem bulrush, softstem bulrush, and western wigeongrass.

Cvancara (1970) reported a total of five mussel species from the Maple River. Two of these, Fusconaia flava and Lampsilis siliquoidea, were represented by empty shells only. Lasmigona complanta, Anodonta grandis, and Anodontoides ferussacianus were all represented by at least one live specimen.

Water Supply

Water supply throughout the subbasin is usually sufficient, either by city ground wells or rural water systems. The community of Enderlin relies on groundwater as a water supply. There is one ground well in operation and one other which is used as a standby. The water is extremely hard and must be processed for domestic purposes. Local water plant officials report an annual consumption rate of approximately 54,750,000 gallons. Farmers in the nearby rural areas sometimes use a rural water system located near Leonard. Casselton relies totally on the same rural water system from Leonard, about twenty miles south. They are also connected with water systems from Page and Hickson as backup sources.

North Dakota Department of Health reports Casselton's annual usage rate as approximately 73,000,000 gallons.

Water Quality

Water quality data for Maple River is limited. The Upper Mississippi River Basin Commission (1977) reports TDS levels in concentrations that exceed 500 mg/l. Table 7 lists the surface water quality of the Maple River at two different sites. The data presented suggests that high concentrations of hardness, sulfates, and boron sometimes help to reduce the stream's water quality.

Table 7

SURFACE WATER QUALITY AT TWO STATIONS IN THE MAPLE RIVER SUBBASIN, OCTOBER 1977 AND MARCH 1978

Parameter	Standard[1]	Hope		Enderlin
		October	March	March
Streamflow (cfs)	--	0.01	111	996
pH (Standard Units)	6-9	7.8	7.9	8.2
Temperature (^{o}C)	32	13	0.5	4.5
Hardness (C_aCO_3)	--	890	74	130
Sulfates	--	810	30	56
Chlorides	250	39	3.4	7.1
Fluoride	--	0.2	0.1	0.1
Total Dissolved Solids (TDS)	1,000	1,600	118	198
Boron (mg/l)	500	520	50	140
Iron (mg/l)	--	100	160	200
Manganese (mg/l)	--	120	20	280

Note: Unless otherwise stated, all units of measure are in milligrams per liter (mg/l).

[1]From Shewman and North Dakota State Department of Health.

Source: U.S. Geological Survey, 1979.

Table 8 presents the groundwater quality data for four communities within the subbasin. Extremely high concentrations of TDS, hardness, sodium, and sulfates occur in Sheldon's water supply. Excessive levels of TDS and hardness are found in Mapleton's water source, also. All

Table 8

GROUNDWATER QUALITY DATA FOR FOUR COMMUNITIES
WITHIN THE MAPLE RIVER SUBBASIN

Parameter	Enderlin	Mapleton	Sheldon	Tower City
Total Dissolved Solids (TDS)	923	1,696	2,816	400
Hardness ($CaCO_3$)	550	490	470	240
Iron	0.2	0.0	1.7	0.3
Manganese	0.3	0.0	TRACE	0.0
pH (Standard Units)	7.3	8.2	7.9	8.2
Fluoride	0.3	0.9	TRACE	0.6
Chloride	25	480	312	6
Sulfates	180	190	1,300	44
Nitrates	4	11	22	5

Source: North Dakota State Department of Health, 1964.

four communities report high levels of these constituents. High chloride concentrations characterize Mapleton and Sheldon's aquifers (North Dakota State Department of Health, 1964).

Aesthetics

The majority of land in the subbasin is included in the flat, featureless plain of former Lake Agassiz. Only a small portion of the area west of the escarpment is characterized by rolling hills, which provide some contrast to vast expanses of agricultural lands. The lack of topographical variety, large bodies of water, and trees in most of the subbasin is the primary factor affecting aesthetic resources in the subbasin. Most of the land has been cleared for agricultural purposes. There are, however, areas of wooded corridors along floodplains of the Maple River and its tributaries which offer residents aesthetically appealing views.

Cultural Elements

Paleo-Indian occupation of much of the eastern portions of the subbasin was probably impossible before 9000-7000 B.P. Prior to this date, much of the glacial Lake Agassiz plain remained poorly drained, perhaps swampy, and certainly inhospitable to early man. The remnant

beach ridges, or strandlines, of glacial Lake Agassiz were probably more likely locales for early human inhabitants than the flat lucustrine plains of the Red River Valley proper. In fact, the earliest indications of man in the Red River Valley are found along the western perimeter of glacial Lake Agassiz in eastern North Dakota (Saylor 1975).

Very little information is available regarding the archeology of the Maple River area, but some site leads do exist for Rich, Page, and Lake townships (Vehik and Vehik 1977:31, 102-3). Some reported possible mound sites located east of Page, North Dakota, would appear to be just outside the subbasin. The archeological significance of these and similar earthen structures here and elsewhere in east North Dakota have not yet been established satisfactorily (see Vehik and Vehik 1977:31). Certainly, not enough archeological information exists at present about the Maple River system to postulate conclusively the expected impacts of potential projects. Without benefit of an archeological survey, it is best to classify effects as "unknown".

High probability areas for prehistoric habitation in the Maple River Subbasin include: beach ridges; the prairie pothole region (waterfowl producion areas and/or "buffalo wallows"); lakes; intermittent streams; the confluence of 2 streams; and along major rivers. Unfortunately, intensive cultivation of much of the region over the past 100 years may have destroyed many surface indications of archeological features. It is reasonable to expect, however, that systematic field reconnaissance will locate many previously unrecorded sites.

The flat and upland prairies of the subbasin were roamed by several Indian groups in proto-historic and historic times. The predominant group of native Americans was the Yanktonai, but perhaps the Sisseton and Wahpeton also used the area. It is probable that the Cheyenne Indians occupied or exploited parts of the subbasin in the late 18th century, perhaps sometime before or after their transition to nomadic Plains Indian culture. The Cheyenne are know to have resided nearby, in a large fortified village along the lower Sheyenne River between 1700-1752 (Hewes 1948:52; Strong 1940:373; and Spencer et al. 1965:351).

The eastern half of the subbasin, in particular, was settled by persons of Norwegian descent in 1869-1870. Most of these Norwegians and some German settlers migrated from Minnesota, Wisconsin, and Iowa to establish new homesteads in the fertile Red River Valley (Robinson 1966:130-31). At this time there are no prehistoric or historic sites listed on or eligible for inclusion on the National Register of Historic Places.

Recreational Resources

Recreational resources are severely limited within the subbasin. There are approximately 766 acres that can be classified as recreational sites. Areas with 15 or more acres are illustrated in Figure III. An inventory of existing facilities at these sites is provided in Appendix B of this report. Although there are more sites under 15 acres in the subbasin, the major areas with more than 15 acres comprise 93 percent of the total subbasin recreational resources.

There are no large natural or artificial lakes to provide water-based opportunities in the subbasin, and there are no large forest tracts to provide wildlife habitat and to sustain a viable population for hunting. There are two small wildlife management areas in the subbasin comprising a total of 317 acres. Species most common to the area include white-tailed deer, squirrel, and rabbits. There are, however, several waterfowl production areas in the western portion of the subbasin which are open for hunting.

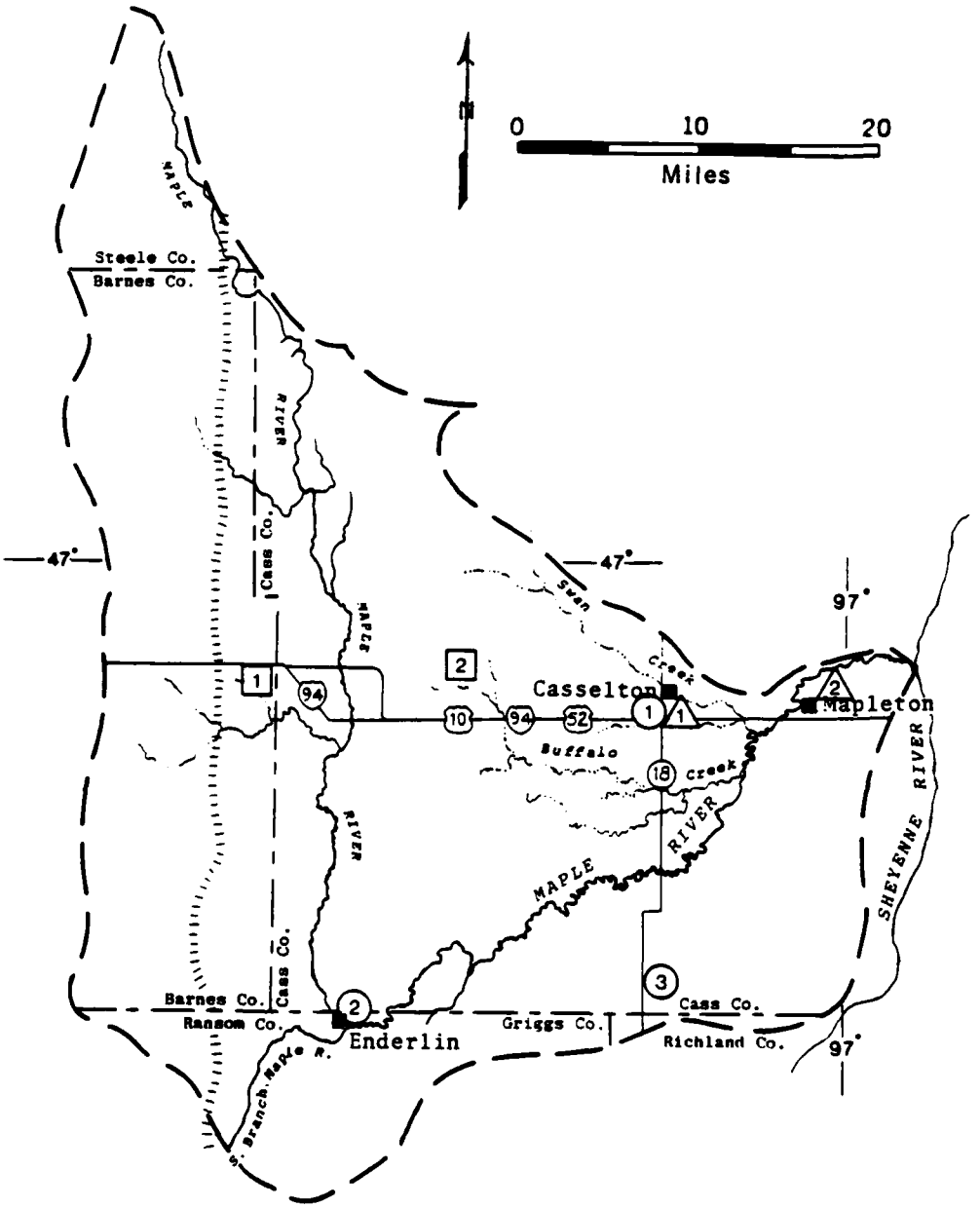
Fishing resources are limited because of water quality problems in the subbasin. Casselton Reservoir, however, has been included in a stocking program managed by the North Dakota Game and Fish Department. Stream fishery includes northern pike, channel catfish and crappie.

The towns located in the subbasin have a variety of municipal parks, golf courses, and school athletic fields which provide non-water-based recreational opportunities. At present, there are no proposed recreation sites in the subbasin.

Significant Environmental Elements

Social

There are a large number of towns in the subbasin; however, most are very small, with under 300 persons. The two population centers of



EXISTING WILDLIFE AREAS

1 Koldak WMA
2 Magnolia WMA

EXISTING RECREATION AREAS

1 Casselton Park
2 Mapleton Park

OTHER EXISTING RECREATION AREAS

1 Casselton Golf Course
2 Enderlin Parks and Golf Course
3 Leonard Golf Course

Source: Gulf South Research Institute.

Figure III. RECREATIONAL RESOURCES

the subbasin are Casselton and Enderlin. The Swan-Buffalo Watershed project has alleviated most flooding problems in Casselton, but the towns of Mapleton and Enderlin incur substantial damages during major floods. The towns affected by flooding sustain damages to low-lying residential areas and to commercial establishments. Roads and bridges may need repairs, adding to municipal and county maintenance costs. The potential for damages to community water supplies and to sewage systems exists during floods.

Agricultural areas are affected by floods because of delays in planting schedules, damages to crops causing reduced yields, repair costs for farm structures and equipment, and the loss of topsoil and increased erosion problems. The towns of the subbasin function primarily as agricultural service centers and may suffer indirect economic losses related to reduced incomes in the agricultural sector.

Cultural

No archeological sites are recorded in the subbasin, and an assessment of significant archeological elements is impossible without more information. Potentially significant cultural resources might well be located and identified with systematic field surveys, which, to date, the subbasin appears to lack. There are no sites listed on the National Register of Historic Places, but a concerted systematic survey would likely identify sites of a local, regional, state, or national significance.

Soils

The soils have developed on four groups of materials: glacial till, glacial lake beds, lake and river terraces, and river floodplains. The soils on glacial till occur in the western part of the subbasin. Those developed on glacial lake beds occur in the region once occupied by glacial Lake Agassiz and consist mainly of silt and clay. Medium textured river terrace soils occur in narrow strips along the streams. Sandy to medium textured lake terrace soils occur along the shorelines of the glacial lake. Predominant soils in the subbasin include the Barnes-Svea and Barnes-Svea-Hammerly associations. These are deep, nearly level to undulating, well and moderately well drained, medium textured soils. The Bearden-Overly association consists of moderately

fine and medium textured soils which contain large amounts of lime at shallow depths. Most of the soils in the subbasin are used for cropland.

Water

Approximately one percent of the total land area of the subbasin is occupied by water areas. The lack of large bodies of water in the subbasin hinders the development of water-based recreational activities.

Woodlands

The woodlands and brushy areas of the subbasin are significant because of their excellent value as wildlife habitats and because of their limited areal extent. Land use data show that only 0.3 percent (2,200 acres) of the total subbasin area (733,440 acres) is forested. Cropland (632,225 acres), range and pasture (48,408 acres), and urban (33,005 acres) are the land uses comprising most of the subbasin. The need exists to protect, conserve, and enhance this major wildlife habitat in the subbasin, wherever possible.

Wetlands

The wetlands of the subbasin are important because of their many beneficial uses and values such as groundwater recharge, sediment and nutrient traps, storage of water during spring runoff and periods of extreme precipitation, habitats for plants and animals, and waterfowl production areas (Cernohous, 1979; U.S. Fish and Wildlife Service, 1979; E.O. 11990, dated May 24, 1977). As with the woodlands, wetlands are significant because their number and areal extent have been decreased through conversion to agricultural lands and other land uses.

Table 9 gives number and acreage values of wetlands in the North Dakota counties included by the subbasin. The figures were obtained during a 1964 inventory based on a 25 percent sampling of the wetlands within these counties. The number and acreage of all Types 3, 4, and 5 wetlands were multiplied by four to expand the 25 percent sample to 100 percent. Type 1 wetlands were not measured in the 1964 survey. The number and acreage of Type 1 wetlands, however, were estimated based on previous studies, which indicated that they comprise about 60 percent of the total wetland numbers and 10-15 percent of the total wetland acres in the Prairie Pothole Region. Although no acreage figures are

Table 9

1964 WETLAND INVENTORY DATA FOR THE FIVE COUNTIES INCLUDED BY THE MAPLE RIVER SUBBASIN

	WETLAND TYPES[a]									
	1		3		4		5		TOTAL	
County	Number[b]	Acres[c]	Number	Acres	Number	Acres	Number	Acres	Number	Acres
Cass	411	414	646	1,938	39	823	-0-	-0-	1,096	3,175
Richland	1,087	2,949	1,464	4,465	316	10,592	32	4,600	2,899	22,606
Barnes	2,642	4,582	4,109	14,898	270	8,522	24	7,128	7,045	35,130
Ransom	2,641	2,271	4,046	8,335	340	4,695	16	2,112	7,043	17,413
Steele	3,816	2,493	5,885	11,123	435	3,832	40	1,664	10,176	19,112
TOTAL	10,597	12,709	16,150	40,759	1,400	28,464	112	15,504	28,259	97,436

[a]Type 1 - Seasonally flooded basins and flats

Type 3 - Shallow fresh marshes

Type 4 - Deep fresh marshes

Type 5 - Open fresh water

[b]Calculated at 60 percent of total wetland numbers.

[c]Calculated at 15 percent of total wetland acres.

Source: U.S. Fish and Wildlife Service (1979).

available for wetlands drained and converted to cropland, most have been drained in eastern North Dakota. Current annual wetland drainage estimates are thought to be less than two percent of the remaining wetland base, except in isolated areas where the rate may be higher (U.S. Fish and Wildlife Service, 1979).

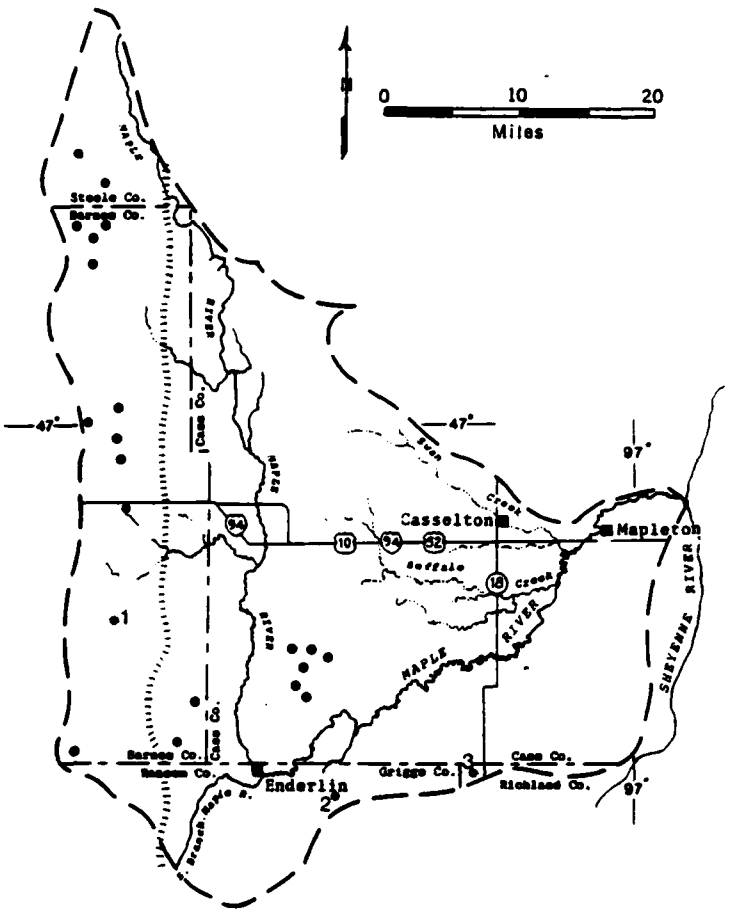
As of 1964, a total of 28,259 wetlands representing 97,436 acres remained within the five counties included by the subbasin.

Waterfowl Production Areas

Waterfowl Production Areas (WPAs) are wetland areas that the U.S. Fish and Wildlife Service (FWS) has either acquired through fee title, or obtained an easement interest in, to preserve valuable breeding, nesting and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of migratory bird hunting and conservation stamps (Duck Stamps). These WPAs are significant because they provide the public with a great variety of wildlife-oriented recreational opportunities, as well as providing valuable habitat for migratory waterfowl and many other forms of wildlife. FWS is responsible for the compatibility determinations (uses) and the issuance and denial of permits involving these lands. WPAs acquired in fee title are managed for optimum wildlife production, particularly waterfowl. On easement WPAs, the rights acquired are limited to the burning, draining and filling of wetland basins and right of access. All other property rights remain with the landowners. The approximate locations of the WPAs acquired in fee within the subbasin are shown in Figure IV. Total acreage of these WPAs, fee and easement, included in the subbasin are listed in Table 10.

Wildlife Management Areas

Two wildlife management areas are situated within the subbasin. A list of these areas and their acreages and locations were presented in the Existing Conditions section for recreation. These areas are significant because of the opportunities provided for outdoor recreation and the protection and management given to biological resources within their confines.



- NATURAL AND SCIENTIFIC AREAS
  - 1 Cuba Marsh
  - 2 Marshland
  - 3 Piper Sandhills
- WATERFOWL PRODUCTION AREAS (Fee Tracts)

*Exact locations and numbers of waterfowl production areas are on file at the U.S. Fish and Wildlife Service, Area Office, Bismark. No copies of these maps have been published or released but can be reviewed at the above office.

Sources: State Comprehensive Outdoor Recreation Plan, 1975; Kantrud, 1973; and U.S. Fish and Wildlife Service, 1980.

Figure IV. WATERFOWL PRODUCTION AREAS AND SCIENTIFIC AND NATURAL AREAS

Table 10

WATERFOWL PRODUCTION AREAS (WPAs) AND WETLAND EASEMENT AREAS OF THE COUNTIES INCLUDED IN THE MAPLE RIVER SUBBASIN

County	WPAs (Acres)	Wetland Easement Areas (Acres)	Total
Barnes	6,586	17,061	23,647
Cass	3,187	1,567	4,754
Ransom	4,153	18,364	22,517
Richland	4,204	416	4,620
Steele	3,570	3,734	7,304
TOTAL	21,700	41,142	62,842

Source: U.S. Fish and Wildlife Service Fee and Easement Interests in Real Property, 1979.

Threatened and Endangered Species

The State of North Dakota considers the blacknose shiner a threatened fish species, and it has been reported from the Maple River. This small minnow inhabits clear lakes, streams, and pools with abundant aquatic vegetation. The blacknose shiner is very sensitive to turbidity. Clearing of streambank vegetation and channelization have caused the decline in the blacknose shiner population. The American peregrine falcon and northern bald eagle are Federally listed as endangered bird species that include the counties of the subbasin in their migratory routes, although neither breeds in the area currently (McKenna and Seabloom, 1979).

Other Important Species

Three peripheral species have been reported by McKenna and Seabloom (1979) to occur within the subbasin: (1) greater redhorse, (2) prairie skink, and (3) pileated woodpecker. The greater redhorse is a fish that normally inhabits large, clear streams which have bottoms of clean sand, gravel, or boulders. This fish is sensitive to increased siltation and pollution. The prairie skink requires open grassy areas with soft, sand soils which allow the skink to burrow deep enough to survive the winter. The pileated woodpecker prefers stands of coniferous or mixed forests. This large bird has been reported from the borders along the Red River and its major tributaries.

Rare and Unique Plants

Barker, et. al. (1976) compiled a list of rare and unique plants of North Dakota by studying plant collections of the North Dakota State University Herbarium. To be included in this listing, a plant must be recorded from three or less counties. If there were only a few individuals at these recorded stations, the species was considered unique. A total of twelve rare or unique species have been reported from the subbasin. These species are listed in Table 11.

Table 11

RARE AND UNIQUE PLANTS OF THE MAPLE RIVER SUBBASIN

Common Name	Status	County	Habitat
Davis' Carex Sedge	Rare	Richland	Aspen wooded area
Marsh Horsetail	Rare	Ransom	Swampy woodland along stream
Canada St. John's Wort	Rare	Ransom	Wet meadows
Wood Fern	Rare	Ransom	Moist woods and along stream banks
Bogbedstraw	Rare	Ransom	Cold swamps and bogs
Bur-Cucumber	Rare	Ransom	Wooded areas
Boneset	Unique	Ransom	Wet meadows, pond and lake margins
Saltmeadow Rush	Rare	Cass	Pond margins
Brook Flatsedge	Rare	Ransom	Shoreline of ponds and streams
Blue Cohosh	Rare	Cass	Rich, moist woods
Water wort	Rare	Cass	Shoreline of streams, ponds, and lakes
Showy Ladyslipper	Rare	Ransom	Boggy and wet wooded areas

Sources: Rare and Unique Plants of North Dakota, Barker, et al., no date; Fish and Wildlife Baseline Data for Maple River Basin and vicinity, U.S. Fish and Wildlife Service, 1978.

Natural Areas

Natural and scientific areas are significant since they normally contain virgin biotic communities or such things as geologic or archeologic features. The Cuba Marsh (Barnes County) and Marshland (Ransom County) are natural areas that support biotic communities representative of the Prairie Pothole Region. The Piper Sandhills is a 100-acre tract of a remnant tall-grass prairie (U.S. Fish and Wildlife Service, 1978; Kantrud, 1973). The approximate location of these areas is shown on Figure IV.

V. FUTURE CONDITIONS

V. FUTURE CONDITIONS

The following is a description of the subbasin's future economic, social, and environmental conditions and resources. This description is presented in terms of "most probable" and "without project" conditions.

Most Probable Economic Conditions

The two principal component counties of this subbasin, Cass and Ransom, are expected by the Lake Agassiz Regional Council to serve as primary and secondary growth centers for the region. This will result in a two percent per decade increase in population (although this pace might accelerate), largely due to Fargo and West Fargo's influence on the eastern portion of the subbasin. These data along with employment and per capita income estimates throughout the study period (1980-2030) are presented below in Table 12.

Table 12

MAPLE RIVER SUBBASIN, POPULATION, EMPLOYMENT, AND PER CAPITA INCOME PROJECTIONS, 1970-2030

Parameter	1970	1977	1980	1990	2000	2010	2020	2030
Population	2,345	12,859	13,100	13,400	13,700	13,900	14,200	14,500
Employment	4,197	6,172	6,300	6,500	6,700	6,900	7,100	7,300
Per capita Income	$6,389	$8,060	$9,900	$12,900	$16,700	$21,800	$28,300	$36,800

Sources: U.S. Water Resources Council, 1972 OBERS Projections, Series E; and Gulf South Research Institute.

The figures in the table were adopted in lieu of the prescribed OBERS E projections, because those projections appear to underestimate growth patterns for the Fargo-Moorhead area, both metropolitan and environs. Steady declines through the year 2020 are anticipated by this series. OBERS E and E' projections were, however, designated as the most probable for per capita income and agricultural activity estimates.

Farming will continue to be the economic mainstay of the subbasin, with communities such as Casselton, Enderlin and Mapleton, serving as service and retail centers for the large agricultural base. The Fargo-Moorhead area, 30 miles from the subbasin, will continue to serve as

the primary retail and wholesale center. Local leaders and area planners point to flooding damages (which in 1979 exceeded $1.6 million) as the biggest obstacles to economic growth.

Most Probable Agricultural Conditions

Approximately 630,800 acres are currently under cultivation in the subbasin, and wheat, barley and sunflowers are the principal crops produced. The estimated value of the total production of these three principal crops is $65.1 million (using October 1979 Current Normalized Prices for North Dakota). Projections of total production through 2030 for these principal crops is presented in Table 13. The projected total production of these three principal crops for the year 2030 is valued at $107.6 million (using October 1979 Current Normalized Prices for North Dakota).

Table 13

MAPLE RIVER SUBBASIN, PRINCIPAL CROPS AND PROJECTED PRODUCTION 1980-2030
(Production in Thousands)

Year	Wheat (Bushels)	Barley (Bushels)	Sunflowers (Pounds)
1980	8,662	7,588	252,820
1990	10,048	8,802	293,271
2000	11,434	10,000	333,722
2010	12,400	10,775	359,004
2020	13,166	11,534	384,286
2030	14,600	11,748	424,738

Sources: OBERS Series E'; and Gulf South Research Institute.

Evaluation of Flood Damages--Future Conditions

A summary of present and future average annual flood damages is presented in Table 14. Assuming a discount rate of 7 1/8 percent, equivalent average annual flood damages are $686,800. Agricultural damages dominated the picture, accounting for 79 percent of this figure, followed by urban damages, accounting for 12 percent, and transportation damages, accounting for nine percent.

Table 14

MAPLE RIVER SUBBASIN, SUMMARY OF PRESENT AND FUTURE AVERAGE ANNUAL DAMAGES, URBAN, AGRICULTURAL, AND TRANSPORTATION
(October, 1979 Prices, 7 1/8 Percent Interest)

	Flood Damages									
Category	1980	1990	2000	2010	2020	2030	Increase 1980-2030	Average Annual Equivalent Factor	Average Annual Equivalent of Increase	Equivalent Average Annual Damages
Urban										
Enderlin	64,800	71,300	77,800	84,200	90,700	97,200	32,400	0.2903	9,400	74,200
Mapleton	7,200	7,900	8,600	9,400	10,100	10,800	3,600	0.2903	1,000	8,200
Agricultural										
Crop	347,100	402,600	458,200	492,900	527,600	583,100	236,000	0.2903	68,500	415,600
Other Agricultural	115,700	125,000	134,200	140,000	145,800	155,000	39,300	0.2903	11,400	127,100
Transportation	61,700	61,700	61,700	61,700	61,700	61,700	--	--	--	61,700
TOTAL	596,500	668,500	740,500	788,200	835,900	907,800	311,300	0.2903	90,300	686,800

Source: Gulf South Research Institute.

Flood damages to residences, businesses, industrial structures, churches, schools, automobiles, house trailers, public property and contents are included in the urban damages category. Damages to streets and utilities (including water, gas, electricity, sanitary sewers, storm sewers, and telephone systems) are also taken into consideration. This category also includes loss of wages, loss of profits, expenditures for temporary housing, cleanup costs, and extra expenses for additional fire and police protection and flood relief.

Agricultural flood damages consist of crop and pasture damage, which may include costs of replanting, refertilizing, additional spraying, reduced crop yields, loss of animal pasture days, and other related flood losses.

Other agricultural damages consist of land damage from scour and gully erosion and deposition of flood debris; livestock and poultry losses; damages to machinery and equipment, fences, and farm buildings and contents (excluding residences); and damages to irrigation and drainage facilities.

Transportation damages include all damages to railroads, highways, roads, airports, bridges, culverts, and waterways not included in urban damages. In addition, all added operational costs for railroads and airlines and vehicle detours are included.

Future growth of urban flood damages was estimated to be an uncompounded (straight-line) rate of one percent per year for a 50-year period beginning in the base year, with no growth thereafter.

Agricultural crop flood damages were projected to increase at the same rate as crop income projections published in the 1972 OBERS Series E projection report. These crop income projections were prepared by the U.S. Economic Research Service (ERS) for the Red River of the North region. Other agricultural flood damages were projected to increase at one-half of this rate.

Transportation damages are not expected to change throughout the project life because of the long-term economic life associated with such structures as bridges, railways, roads, and culverts. In addition, it has been found that repairs to these types of structures rarely exceed the cost of a new structure, even with frequent flooding.

Most Probable Environmental Conditions

Native woodlands and wetlands are expected to decline further with the conversion of these lands to agricultural and other uses. Woodland losses may be offset to some extent with plantings of shelterbelts, windbreaks, and greenbelts through such programs as 208 planning. However, these plantings may or may not be of comparable quality. Decreases in these habitats will result in reduced plant and animal populations that depend wholly or in part upon these environs.

Water quality improvements will occur with successful implementation of point and nonpoint source pollution abatement programs. The nonpoint source program will take substantially longer to implement. These improvements will benefit both aquatic biota and wildlife utilizing aquatic habitats. Periodic problems are expected to continue with low or intermittent stream flows.

Without Project Conditions

It is likely that the scenario set forth as the most probable future of the subbasin will prevail during the 50-year planning period in the absence of a plan to alter resource management programs.

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

Institutions

The development of effective water resources management practices in the subbasin is affected by a large number of Federal, state, and local agencies involved in project planning and implementation. There are 44 Federal agencies with various types of jurisdictions and 14 directly involved in the water and related land resource planning process. At the state level, seven agencies are involved. There are also regional commissions, county agencies, and municipal entities. Differences in perspective and problems of coordination hamper the effective and speedy resolution of problems.

The subbasin is limited in efficient flood control planning because of the large number of agencies with jurisdiction in the area and the lack of an overall subbasin approach to flood control planning. The water management districts are the most important local entity involved in developing water resources programs. The districts have broad powers relating to flood control, water supply, and water conservation planning. The following water management districts have authority in the subbasin: Barnes, Richland, Ransom, Steele, North Cass, Rush River, Southeast Cass, and Maple River. The Southeast Cass district is the only one with an overall water resources plan. There is no unified plan which addresses flooding problems on a subbasin perspective. In addition, there are five soil conservation districts with water and related land management responsibilities in the subbasin, including those districts representing Barnes, Richland, Cass, Ransom, and Steele counties.

The major Federal agencies with water resource development interests in the area are the Soil Conservation Service (SCS) and the Corps of Engineers. The Corps of Engineers developed a flood control measure for the Maple River at Enderlin, and a project to construct levees at the town has been authorized. The SCS completed a flood control measure for the Swan-Buffalo Creek Watershed in 1969. The Corps of Engineers, SCS, the North Dakota State Water Commission, eight water management districts, and five soil conservation districts should be consulted in devising flood control measures for the subbasin. It should be noted

that the Red River, Lake Agassiz, and South Central Regional planning councils have developed comprehensive land use plans that include the subbasin area.

Structural Measures

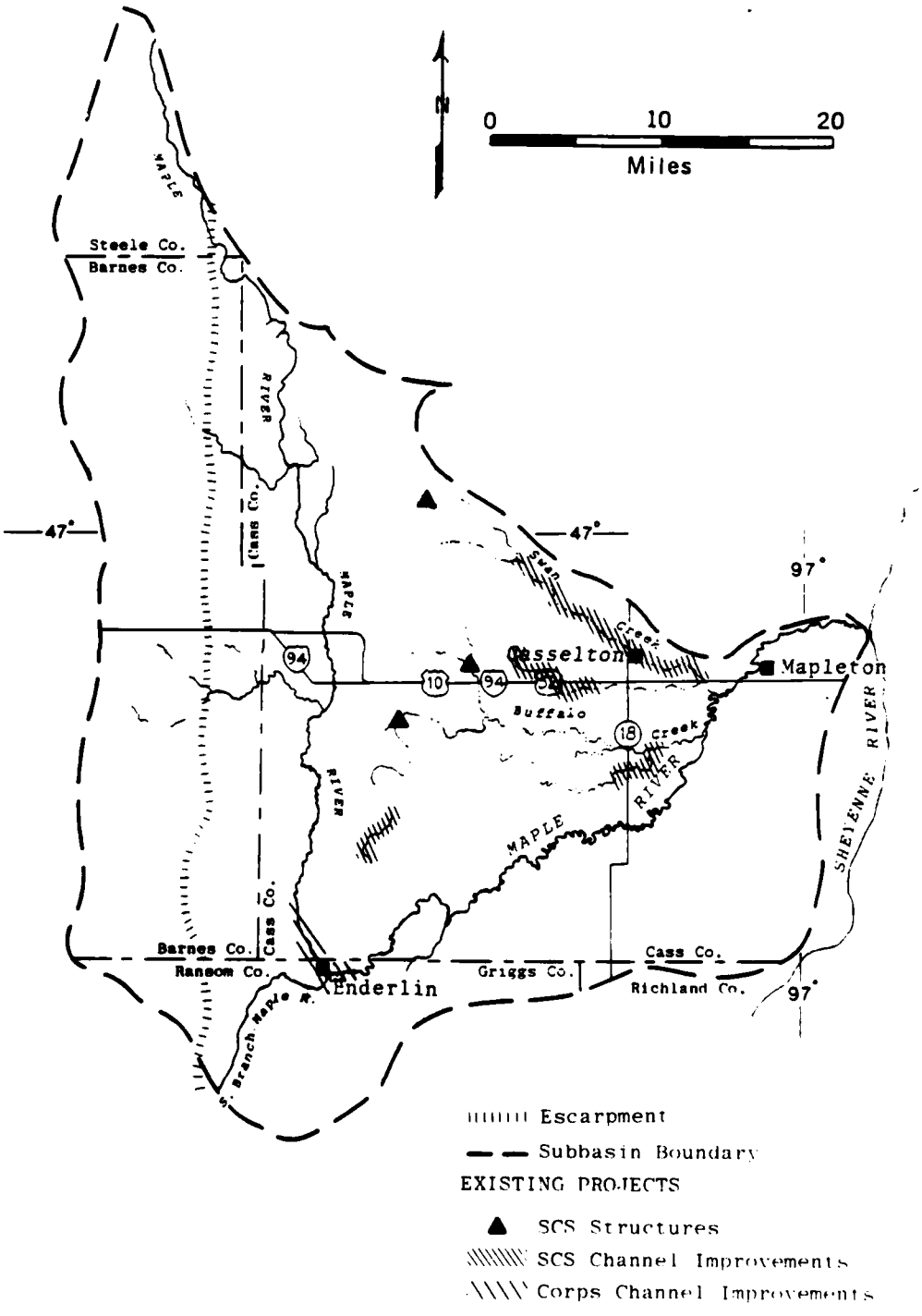
There have been numerous private and legal drains constructed in the Maple River Subbasin. Under the authority of Public Law-566, the Soil Conservation Service (SCS), in cooperation with local interests, has completed one floodwater control and agricultural management (drainage) project, and the Corps of Engineers also has constructed one flood control project in this subbasin. The location of structural measures included in these projects are shown in Figure V and include the following:

1. The Swan-Buffalo Creek Watershed project was completed in 1969. It included both land treatment and structural measures for flood control and prevention. Structural measures include three floodwater retarding structures, with a total flood storage capacity of 4,902 acre-feet, and 31.8 miles of channel improvements and floodways. The project provides 10 percent flood protection for this 318 square mile watershed, which is 28 percent of the subbasin area.
2. In 1956, the Corps of Engineers completed a channel clearing and snagging project at Enderlin, North Dakota extending over a distance of one mile in four separate reaches of the Maple River in this area.

Nonstructural Measures

Nonstructural flood control measures are measures that reduce or eliminate flood damages through procedures that involve little if any construction efforts. Typically, these types of measures will include flood warning and emergency protection, floodplain zoning and regulation, flood insurance, flood proofing and floodplain evacuation. These measures are primarily applicable to urban areas.

The towns in the subbasin participate in the Red River Valley flood warning system. The flood warning system for the Red River Valley is a cooperative network organized by the National Weather Service in Fargo, North Dakota. Fifty volunteers throughout the basin report to the National Weather Service on a weekly basis during winter and fall and on a daily basis during spring and summer. The reportage covers all precipitation



Source: Gulf South Research Institute.

Figure V. EXISTING FLOOD MEASURES CONTROL

of 0.1 inch or more, including amounts of snow and water equivalent. This information is transmitted to the River Forecasting Center in Minneapolis, where it is run through a giant computer system to determine probable flood stages. The predictions are then transmitted to the National Weather Service in Fargo, which releases them to the public through the news media. Communities are then able to engage in emergency actions to protect themselves from flood damages. Contacts with local officials indicate the flood warning system generally works quite well in the subbasin.

Floodplain regulation and flood insurance are currently required by Federal policies and encouraged by the State of North Dakota. Floodplain regulation is the regulation of any new developments in existing floodplain areas thereby preventing or reducing future flood damages. However, because home and business owners in flood prone areas can obtain structural improvement loans through the purchase of flood insurance and because the value of the contents of these structures is expected to increase, flood damages will increase in the short run even with floodplain regulations in effect.

There are other types of measures that could be implemented in the subbasin to reduce flood damages but that are not directly applicable to urban areas. These measures would include such things as land treatment programs, use of present drainage ditches for floodwater storage and use of natural areas for reversion to water retention use. Land treatment is used by some farmers in the subbasin in cooperation with the Soil Conservation Service (SCS), but exact participation is unavailable.

Information on natural storage areas and potentialities for increased storage is limited. Indications are, however, that wetlands play a substantial role in controlling runoff, especially in combination with good land treatment practices. Valves on storage have averaged about twelve inches per surface-acre of wetlands and have ranged to four times that amount (Cernohous, 1979). The amount of wetland habitat within the watershed area (or subbasin) is important: statistical studies indicate that in certain situations if a watershed has 15 percent of its area in wetlands or lakes, peak floods will be 60 to 65 percent lower than they would be in the absence of the wetland/lake area;

if wetlands or lakes occupy 30 percent of the watershed, there will be a further reduction in flood peaks up to about 75 to 80 percent (Scientists' Report, National Symposium on Wetlands, 1978). Additional Nonstructural Alternative Study Recommendations have been included in Section XI on pages 65-66 of this report.

Adequacy of Existing Measures

The Swan-Buffalo Watershed project is providing excellent flood protection in both rural and urban areas. The Swan Creek channel improvement and floodwater retarding structure protected the City of Casselton from flooding on four different occasions since 1962. This project has practically eliminated flooding at Casselton. The three SCS reservoirs have reduced the one percent (100-year) flood discharge at the Red River of the North by about 1,000 cfs.

The Corps of Engineers project at Enderlin is performing satisfactorily; however, this project provides relief for only minor floods. Enderlin still incurs substantial damage during major floods. Mapleton also suffers damages during major floods, although the damages are not as extensive as at Enderlin. The public and private drainage ditches relieve some localized minor flooding but are inadequate for major floods. Although existing structural flood control measures provide some relief from flooding, they are not extensive enough or adequate for most floods. With the exception of the Swan-Buffalo Creek Watershed, recurring flooding is still a serious problem throughout this subbasin even for frequent floods. Additional structural flood control and prevention measures are needed to reduce flood damages in the Maple River Subbasin.

VII. CRITERIA AND PLANNING OBJECTIVES

VII. CRITERIA AND PLANNING OBJECTIVES

Floodplain Management Criteria

Technical, economic, and environmental criteria must be considered when formulating and evaluating alternative floodplain management measures for the subbasin.

The technical criteria used in formulating and evaluating alternatives for this report consisted of the application of appropriate engineering standards, regulations, and guidelines.

Economic criteria entailed the identification and comparison of benefits and costs of each measure. Tangible economic benefits must exceed costs; however, in certain instances, considerations of appropriate gains in the other accounts (environmental quality, social well-being and regional development) could alter this requirement. All alternatives considered are scaled to a design which optimizes benefits. Annual costs and benefits are based on an interest rate of 7 1/8 percent and price levels and conditions existing in October 1979. A 50-year amortization schedule is used for the features considered.

Environmental considerations call for the formulation of measures that minimize objectionable or adverse environmental effects and maximize environmental benefits. Also, limited consideration was given to modifications based on coordination with state and Federal agencies, local interests, and citizen groups.

Planning Objectives

The primary planing objective of this study was to contribute to flood reduction needs in the subbasin and thereby provide protection from or reduction of flood losses. In conjunction with this economic objective, the study attempted to develop contributions to the environmental quality of the subbasin.

The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information that was available. On the basis of this analysis of the identified problems, needs, and desires, the following planning objectives were established:

1. Contribute to protection from and prevention, reduction, or compensation of flood losses for the flood prone areas of the subbasin during the period of analysis.

2. Contribute, to the maximum extent possible, to the preservation of the quality of the existing riverine environment and enhance the environmental potential of the subbasin as a whole.

3. Contribute to the enhancement of recreational opportunities throughout the subbasin.

4. Contribute to the improvement of water quality in the Maple River.

5. Contribute to the improvement of water supply throughout the subbasin.

6. Contribute to the reduction of wind and water erosion throughout the subbasin.

7. Contribute to the development of irrigation throughout the subbasin.

8. Contribute to the reduction of wastewater management problems, particularly insofar as they relate to water quality.

VIII. FORMULATION OF ALTERNATIVE MEASURES

VIII. FORMULATION OF ALTERNATIVE MEASURES

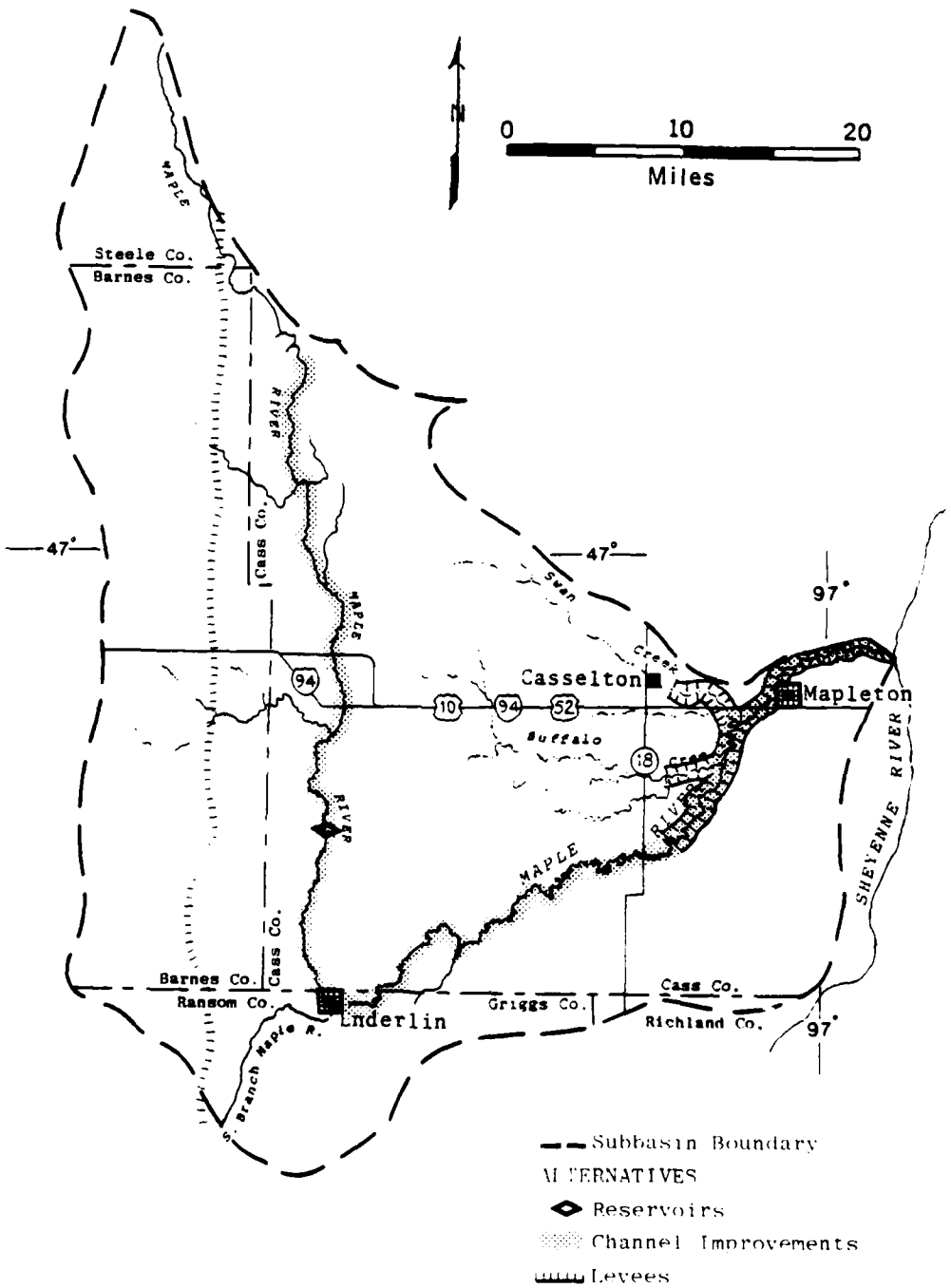
Management objectives which have been identified to satisfy the resource management objectives are discussed in this section. In the formulation of measures, prime consideration was given to the resolution of flooding problems. Measures to satisfy the other planning objectives were considered exclusively as components of the flood control measures. The average annual area flooded in this subbasin is 5,470 acres, of which 5,197 acres are improved farmland. The following measures, which are identified on Figure VI, were devised in response to the flood control planning objective:

1. A flood control reservoir north of Enderlin and improvements to the existing Upper Maple River channel to contain the 10 percent (10-year) flood. The reservoir would have 47,000 acre-feet of flood storage capacity. The capacity of this reservoir could be increased somewhat for multi-purpose use. Approximately 64 miles of the Upper Maple River channel would be enlarged to contain the 10 percent flood. The combination reservoir and channel improvement would provide about 7.5 percent (13.3-year) flood protection for this subbasin and would protect 5,600 acres in the one percent (100-year) floodplain. The implementing agency would be the Corps of Engineers.

2. Enlarge the Upper Maple River and main stem Maple River channels to contain the 10 percent (10-year) flood. This measure includes the 64 miles of channel improvement along the Upper Maple River in Alternative 1, and 70 miles along the main stem from the Upper Maple to the Sheyenne River. This measure would provide 10 percent flood protection for the subbasin. Also, it would protect about 4,600 acres in the one percent floodplain. The implementing agency would be the Corps of Engineers.

3. Clearing and snagging the Upper Maple river and main stem Maple River to provide 30 percent (3.3-year) flood protection. This measure covers the same channel reach as Alternative 2. It would provide 30 percent flood protection for the subbasin and protect 2,000 acres in the one percent floodplain. The implementing agency would be the Corps of Engineers.

4. Construct 25 miles of agricultural levees along each side of the Maple River main stem channel and 7 miles each along the channels of Swan and Buffalo creeks, all to high ground. This measure provides one percent flood protection for



Source: Gulf South Research Institute.

Figure VI. ALTERNATIVE FLOOD CONTROL MEASURES

the subbasin and protects 15,000 acres in the one percent floodplain, which would have a maximum width of about 6,500 feet near its junction with the Sheyenne, and would narrow to about 800 feet at its upstream termination. The implementing agency would be the Corps of Engineers.

5. Flood protection for urban areas at Enderlin and Mapleton. These measures, one at each community, would provide one percent flood protection for the towns, but would not provide flood protection for rural areas. The Corps of Engineers presently is preparing a detailed project report to determine the feasibility of constructing the protection measure at Enderlin. The implementing agency would be the Corps of Engineers.

6. Construction of farmstead levees around individual farmstead in the one percent floodplain. The levees would protect individual farmsteads against the one percent flood and could be constructed by the SCS, Corps of Engineers, or private interests.

Engineering Methodology

There were considerable data gaps in existing Maple River Subbasin information. Of particular significance was the lack of streamflow and hydrological data and gaps in USGS Quadrangle Map coverage of the subbasin. In the absence of streamflow data, information from the Goose River Subbasin was used. The Goose River Subbasin is adjacent to the Maple and similar in size, climate, land use and topography. Where there were gaps in quadrangle map coverage, Corps of Engineers 1:250,000 scale maps were used.

In order to develop the flood damage reduction measures and resulting benefits, flood probability vs. discharge curves were derived on the basis of Goose River data. Existing channel capacities were estimated from information available for stream channels in other subbasins. Generalized curves developed from other subbasins in the course of this study and the derived flood probability vs. discharge curve were used to estimate floodplain reductions that would result from implementing the various measures. The channel modification, reservoir, and agricultural levee measures were analyzed on the basis of one, 7.5, 10, and 30 percent floods as applicable. All this derived data was used to produce a set of curves showing area flooded vs. percent of chance of occurrence in one year for each measure and the existing condition. This set of curves was used to estimate

average annual area flooded and average annual benefits. In estimating average annual benefits and damages, the effect of woodlands has been taken into account. Flood control and prevention measures were analyzed on the basis of the effects of subbasin flooding occurring independently of flooding caused by Sheyenne River backwater and/or overland flooding from other streams.

The reservoir location and estimated capacity were determined from quandrangle maps. The SCS and North Dakota State Water Commission have investigated several prospective dam sites in this subbasin that were found to be unsatisfactory. However, existing data indicate that the site north of Enderlin would be satisfactory for a dam.

Capital costs for the various alternative measures were estimated by using October 1979 price level unit construction costs and updating capital costs from prior studies and reports to October 1979 price levels using appropriate "Engineering News Record" cost indexes. The reservoir capital cost was determined from a cost vs. volume curve for reservoirs developed from cost data in prior studies and projects in the St. Paul District, other Corps of Engineers District projects and studies, Bureau of Reclamation projects, and Tennessee Valley Authority projects. Capital costs for the levee measure are based on using portable pumps. The farmstead levee capital cost is based on the assumption that individual owners would build their own levees.

It should be emphasized that there is very little data available for the Maple River Subbasin. This analysis of flood damage reduction, floodplain reduction and benefits is based on this limited data and data from similar subbasins.

Nonstructural Measures

Among the nonstructural measures considered were flood warning and forecasting services, emergency protection measures, permanent floodplain evacuation, flood proofing, and floodplain regulation. These measures are discussed in the following paragraphs.

Floodplain regulation and flood insurance are currently required by Federal policies and encouraged by the state of North Dakota. This measure primarily consists of regulating new development in existing

floodplain areas and the insuring of affected property owners for losses from flood damages. Floodplain regulation should be a part of any flood protection system and could be effective in this subbasin. As a supplement to floodplain regulation, flood insurance could provide limited protection to existing developments. In the longrun, floodplain regulation would theoretically eliminate all nonconforming floodplain structures, thereby reducing flood damages.

Unsubsidized crop insurance is available through the U.S. Department of Agriculture Federal Crop Insurance program, which covers all natural disasters including floods. However, actual crop damages could be reduced only to the extent that intensive farming practices would be discouraged in the longrun in the floodplain. Because of the highly productive nature of the floodplain, it is very doubtful that any longrun shift away from intensive farming of floodplain areas would occur.

Flood warning and forecasting services in conjunction with emergency protection measures have been used with reasonable success. Evacuation is possible due to the prolonged nature of the rise of flood waters from major flood events; but particularly in the case of summer floods, time would not permit the erection of emergency flood protection works. The broad extent of the floodplain, the large number of persons involved, and the unavailability of facilities in neighboring communities to accommodate affected persons precludes this alternative from being economically or socially acceptable as an effective means of solving flooding problems in the subbasin. However, it is recommended that flood warning and forecasting services be continued in order to alert floodplain residents of impending dangers.

Permanent evacuation of flood prone areas would consist of the acquisition of lands, relocation of improvements and resettlement of the population, ultimately resulting in the conversion of land use to a state less susceptible to flood damages. Impacts of this alternative would primarily be cultural and economic in nature. Flood proofing would involve structural changes and adjustment to properties in an effort to reduce or eliminate flood damages. This is most effective when applied to new construction, but can be applied to existing structures in some instances. Permanent evacuation

would result in the disruption of long-established social and cultural relationships, but could eliminate flood damages to structural units, providing that floodplain regulations were enforced. Furthermore, health and safety of floodplain residents would be enhanced, and natural habitats would be improved. However, the residual damages to agriculture and the economic, social and cultural impacts of these two measures would more than offset the benefits.

The preceding discussion summarizes the results of prior Corps of Engineers investigations. In addition to the nonstructural measures mentioned in the Corps reports, there is an opportunity for the use of land treatment measures throughout the subbasin that help to contain water on land as well as reducing runoff related erosion damages. Other measures would include, but not be limited to, water retention in existing ditches and preservation of natural retention areas. These would need to be identified and retention capabilities would need to be determined. Wetland restoration could also be considered, where appropriate, for water retention.

IX. ASSESSMENT OF ALTERNATIVES

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Economic Assessment

Recurrent flooding problems in the subbasin are aggravated by the extremely flat topography and limited channel capacities. In the largest floods, approximately 21,000 acres of cropland have been inundated along the flat floodplain. In addition to the extensive flooding of rural areas, severe flood problems exist at the urban developments of Enderlin and Mapleton. The flood control measures analyzed in Table 15 were developed with these particular problems in mind.

Alternative one consists of a flood control reservoir north of Enderlin in conjunction with improvements to the existing Upper Maple River channel. Economic evaluation of this alternative yielded a benefit/cost ratio of 0.25.

Alternative 2 consists of enlarging the Upper Maple River and main stem Maple River to contain the 10 percent (10-year) frequency flood. Economic evaluation of this alternative yielded a benefit/cost ratio of 0.25.

Alternative 3 consists of clearing and snagging the Upper Maple River and main stem Maple River to provide 30 percent (3.3-year) flood protection. Economic evaluation of this alternative yielded a benefit/cost ratio of 1.47.

Alternative 4 consists of 25 miles of agricultural levees along each side of the Maple River main stem channel and seven miles each along the Swan and Buffalo creeks (all to high ground). Economic evaluation of this alternative yielded a benefit/cost ratio of 0.08.

Alternative 5 consists of the construction of urban levees around the community of Enderlin that would provide one percent (100-year) frequency flood protection. Economic evaluation of this alternative yielded a benefit/cost ratio of 0.30. The St. Paul District of the Corps of Engineers is currently preparing a Detailed Project Report to determine the feasibility of constructing the protection measure at Enderlin. It is highly probable that this current and more detailed assessment of this alternative will yield a more favorable benefit/cost ratio.

Table 15

ECONOMIC EVALUATION OF ALTERNATIVES

Alternatives	Acres Protected	Average Annual Acres	Capital Costs	Average Annual Costs	Average Annual Rural Benefits	Average Annual Urban Benefits	Total Average Annual Benefits	B/C Ratio
1. Upstream Reservoir and (47,000 Acre Feet) Channel Improvements (10% flood)	5,600	4,185	$23,260,000	$1,712,200	$356,900	$63,400	$420,300	0.25
2. Channel Improvements, Enlargement (10% flood)	4,600	3,986	21,623,000	1,591,700	340,000	60,200	400,200	0.25
3. Channel Improvements, Staging and Clearing (30% flood)	2,000	2,584	1,705,000	125,500	145,400	38,700	184,100	1.47
4. Agricultural Levees (1% flood)	15,000	646	10,725,000	789,500	55,100	8,200	63,300	0.08
5. Urban Levees at Enderlin (1% flood)	--	--	3,348,000	246,400	--	74,200	74,200	0.30
6. Urban Levees at Mapleton (1% flood)	--	--	544,000	40,000	--	8,200	8,200	0.21
7. Farmstead Levees	--	--	$ 5,600	$ 400	$ 840	$ --	$ 840	2.10

Source: Gulf South Research Institute.

Alternative 6 consists of the construction of urban levees around the community of Mapleton that would provide one percent (100-year) frequency flood protection. Economic evaluation of this alternative yielded a benefit/cost ratio of 0.21.

Alternative 7 consists of the construction of farmstead levees around individual farmsteads in the one percent (100-year) frequency floodplain. The levees would protect individual farmsteads against the one percent frequency flood and could be constructed by private interests.

Impact Assessment

Table 16 presents a generalized assessment of the effects on the resource elements that can be expected if the measures were to be implemented.

Upstream Reservoir and Channel Improvements

Flood damage reduction measures that encompass 47,000 acre-feet of storage in multi-reservoir sites and 64 miles of channel improvement to the Upper Maple River would have moderately beneficial social and economic effects in the subbasin. The benefits would accrue mostly from protection for rural areas and existing urban developments against a 13.3-year frequency flood and 5,600 floodplain acres against a 100-year frequency flood. Recreation would be beneficially, although minimally, affected.

Minimally adverse effects would be experienced by land use elements as a result of the impoundments. A similar level of disruptive effects would occur to biological elements (because of the disruptions and changes in existing habitat) and to water quality (turbidity and sedimentation). It is not known to what extent water supply and cultural elements would be affected.

Channel Improvements

Channel improvements would yield moderately beneficial social and economic effects, some moderate to maximally adverse biological effects, and adverse results for water quality elements. It is not known what effects would take place with respect to land use, water supply, and cultural elements, while minimally positive recreation benefits would result from such actions.

Table 16

ASSESSMENT OF MEASURES, BY RESOURCE ELEMENT, MAPLE RIVER SUBBASIN

Measures	Social	Economics	Land Use	Biology	Water Quality	Water Supply	Cultural	Recreation
1. Upstream Reservoir and Channel Improvements (10 % flood)	MoB	MoB	MiA	MiA	MiA	NkE	NkE	MiB
2. Channel Improvements (10% flood)	MoB	MoB	NkE	MaA	MoA	NkE	NkE	MiB
3. Channel Improvements (30% flood)	MoB	MiB	NkE	MoA	MoA	NkE	NkE	MiB
4. Agricultural Levees (1% flood)	MoB	MoB	NkE	MoB	MiA	NkE	NkE	MiB
5. Urban Levees-Enderlin (1% flood)	MoB	MoB	NkE	MiA	NkE	NkE	NkE	NkE
6. Urban Levees-Mapleton (1% flood)	MoB	MoB	NkE	MiA	NkE	NkE	NkE	NkE
7. Farmstead Levees	MiB	MiB	NkE	Nke	NkE	NkE	NkE	NkE

Note: NkE = No Known Effect
MiA = Minimally Adverse
MoA = Moderately Adverse
MaA = Maximally Adverse
MiB = Minimally Beneficial
MoB = Moderately Beneficial
MaB = Maximally Beneficial

Source: Gulf South Research Institute.

Social and economic benefits would accrue from the flood protection and flooding reductions that would stem from the project. Some 2,000 to 4,600 acres in the subbasin would be afforded such protection, depending on the alternative selected. Possible oxbow lakes and trails for summer and winter use would yield recreational benefits. Biological and water quality elements would be affected negatively by dredging activities, placement of dredged material, vegetation removal, and temporary turbidity.

Agricultural Levees-Maple River and Swan and Buffalo Creeks

The Maple River agricultural levees would afford protection to 15,000 acres, and thus would be moderately beneficial from an economic and social standpoint. The levees would provide primary benefits in the way of economic advantages to the agricultural lands in the flood prone areas of the Maple River and tributary creeks (reduced flooding, earlier planting dates, fewer crop losses, etc). Most of the social benefits would accrue from reduced flood damages to residences and farmsteads, fewer rural community disruptions, and reduced threats to public health and safety during flood periods. Adverse social effects would occur because largely agricultural lands would be needed to provide for rights-of-way and easements.

Moderate to maximum beneficial effects are anticipated for wildlife resources, since the large setbacks would induce development of a riparian community. Adverse effects would occur to water quality as a result of increased turbidity from construction activities, but the effect would be minimal because of the large setback of the levees. It is not known how land use, water supply, and cultural elements would be affected, if at all. Minimum beneficial recreation benefits would accrue from fishing activities in borrow areas.

Urban Levees-Enderlin and Mapleton

Prevention of flood damages at Enderlin and Mapleton would result in moderately beneficial social and economic effects to the community and subbasin. These beneficial effects include the reduction or prevention of damages to and/or loss of personal property, the potential for disruptions

in the delivery of emergency service, drains on community services, temporary or permanent loss of community facilities, loss of community tax base and losses in personal income. In addition, such measures would serve to reduce many of the negative behavioral consequences associated with flooding problems. It is not known what effects, if any, would be experienced by land use, water quality and supply, cultural elements, and recreational elements.

Minimally adverse environmental and biological impacts would accrue as a result of project construction. Some streamside floodplain vegetation would be destroyed by project construction, and there would be minor degradation in aesthetic qualities and temporary air and noise pollution.

Farmstead Levees

Minimally beneficial economic and social effects would result from the protection of several farmsteads in the 100-year floodplain. All other resource elements would not be significantly affected, although consideration must be given to public health and aesthetic factors prior to their construction.

X. EVALUATION

X. EVALUATION

Only two of the eight measures analyzed for the subbasin have benefit/cost ratios that exceed unity. They are: (1) channel improvements (clearing and snagging) of the Upper Maple River and mainstem Maple River; and (2) the farmstead levees.

Both of the measures would have favorable social well-being effects, although to a considerably lesser extent than several of the alternatives which did not surpass the unity criteria. New economic benefits are maximized with the clearing and snagging channel improvements. Although the farmstead ring levees also exceed the above unity measurement, they do not notably benefit the resolution of subbasin flooding problems.

Great environmental enhancement would result from the agricultural levees associated with protecting 15,000 acres, since protection would be afforded to the riparian belt and would create or expand habitats associated with levee setbacks.

National Economic Development (NED) and Environmental Quality (EQ) plans will be tentatively formulated in association with the Red River of the North Basin main reconnaissance report.

XI. ADDITIONAL STUDY NEEDS

XI. ADDITIONAL STUDY NEEDS

This report was developed almost entirely on the basis of secondary information from readily available planning documents. Data available from state and Federal agencies was not fully canvassed, and only a limited number of calls were made to the area. In particular, state university libraries and department resources could not be fully utilized. Thus, the document aims only at a broad-brush perspective. In order to provide a more detailed and in-depth analysis of subbasin resources, problems, and potential solutions, the following additional study needs would have to be fulfilled:

1. A literature search should be conducted to obtain available biological data for the subbasin. Fieldwork should be planned to fill in any data gaps which exist with the end result of obtaining good baseline data for the subbasin. This includes those areas where new flood control measures have been proposed, as well as updating any data for those projects which have been previously studied.
2. Areas of high environmental quality (e.g., prairie remnants; riparian woodlands) should be identified and inventoried within the subbasin.
3. Updated knowledge of the location, areal extent, and types of wetlands occurring within the specific subbasin boundaries would be extremely useful in determining whether wetland restoration would assist in alleviating flooding problems, as has been indicated by Cernohous (1979), and would provide a comparison for documenting wetland losses since the 1964 inventory.
4. Primary water and sediment quality data need to be obtained or updated to characterize baseline conditions in the streams of the subbasin, particularly in those areas where flood control measures have been proposed.
5. Information pertaining to wastewater management needs to be updated.
6. The information obtained in items 1-5 above would provide an important data base upon which an impact evaluation of proposed flood control measures can be performed and would provide information relative to the cumulative effects of flood control projects on environmental resources in the subbasin. These projects include those that are in-place or proposed.
7. Nonstructural flood damage reduction measures should be thoroughly explored such as those listed below.

- Establishment of buffer areas and curtailment of inappropriate residential, commercial, and other development in floodplains.
- Maintenance and enhancement of existing riparian vegetation along the Maple River and tributaries to conserve and restore wildlife habitats, help control wind and streambank erosion, retain soil on the land, and reduce the amount of sediment, nutrients, and other pollutants entering waterways.
- Maintenance of grassed waterways to reduce erosion.
- Establishment of vegetation in areas of critical erosion.
- Determination of the feasibility of installing water control structures at existing culverts to retain water in drainage ditches for longer periods of time during critical runoff periods to minimize flooding in downstream areas.
- Determination of the feasibility of utilizing "on-farm storage" to control runoff through such means as natural storage areas and control structures on existing culverts.
- Prevention of overgrazing on grasslands and utilization of sound agricultural land use practices.
- Provision for strict enforcement of floodplain management programs within the subbasin.

8. The potentiality for land treatment measures (e.g., erosion control measures such as cover crops, green belts, reduction in fall tillage, etc.) needs to be thoroughly investigated.
9. The people of the subbasin need to be included in further water resource planning efforts. A public involvement program would provide more complete information on water resource problems and opportunities than is presently available.
10. More study is needed to determine the precise nature of the water supply problems and potential solutions.
11. Potentialities for floodwater storage in present drainage ditches need to be investigated.
12. The effect of drainage works on flood discharges and stages is unknown at present. It would take additional, more detailed studies to determine the extent and effect of reduced natural storage.
13. Land use within the floodplain needs to be precisely identified.
14. An adequate 100-year floodplain map needs to be developed. Also, the extent of floodplains for smaller frequency storms needs to be delineated.

15. More gauging stations need to be developed to provide hydrologic data for establishing flood frequencies and rating curves.

16. Channel cross-sections of the various streams need to be prepared for flood control planning purposes.

17. Crop distribution in the floodplain needs to be precisely identified through contact with county agents, and average annual rural damages need to be updated.

18. The irrigation potentials of the subbasin soils need to be investigated.

19. A comprehensive and up-dated inventory of recreation sites would be required to accurately identify resources.

20. Studies are needed to determine additional demand for recreational facilities, usage of existing facilities, and potential sites.

21. A regional supply and demand analysis for hunting, fishing, and other water based or related recreational pursuits is needed.

22. Whether forested acreages in the floodplain are increasing or declining needs to be precisely determined.

23. A detailed institutional analysis of the subbasin is needed. Part of this analysis would be a detailed study of the objectives, goals, and programs of the many institutional entities involved in water resources planning, particularly at the local level, is needed to determine the most efficient institutional approach to the resolution of flooding problems.

24. A detailed social profile of the subbasin is needed.

25. Urban damages need to be recomputed in a systematic fashion.

26. A review of secondary sources and systematic field reconnaissance is needed to identify archaeological and historical sites and to determine their eligibility for nomination to the National Register of Historic Places.

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Appendix A
FLOODPLAIN DELINEATION

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FLOODPLAIN DELINEATION

Prior to this study, no attempt was made to publish even a generalized delineation of the entire Maple River floodplain. In undertaking this task, the present study utilized all known sources to provide the best available data for generalized delineation of the U.S. portion of the subbasin at a scale of 1:250,000. Principal sources were: USGS Flood Prone Area Maps (scale 1:24,000), Corps of Engineers photomosaics of the 1979 flood, Federal Insurance Administration flood maps for available incorporated and unincorporated areas, published secondary sources, U.S. Geological Survey (USGS) 7½ minute Topographic maps, and other sources, including derived data where necessary.

The Flood Prone Area Maps published by the USGS provided detailed and highly accurate information of the area mapped. Six primary sheets provided coverage in the Enderlin and Casselton areas. Several other sheets included part of the subbasin, but focused on adjoining watersheds. Eight USGS 7½ minute quad sheets covering the central and southern part of the subbasin were also available for reference.

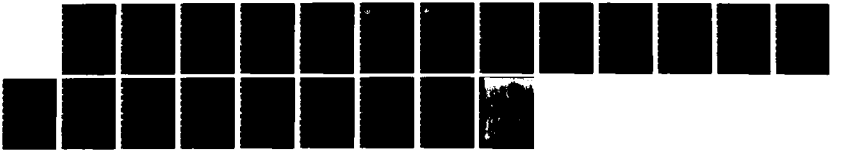
Unlike the extensive coverage of the Minnesota side provided by Federal Insurance Administration flood maps, only selected incorporated areas are generally available in North Dakota. The only exception is Cass County, for which a flood map was published in 1971 covering the unincorporated area in the eastern one quarter of the county. Barnes and Ransom counties joined the emergency program in 1978, but are not as yet mapped. Richland and Steele counties are not listed as participants in the program. Maps of incorporated areas for Casselton, Kindred, Mapleton, Tower City, and Enderlin provided limited, but useful, information.

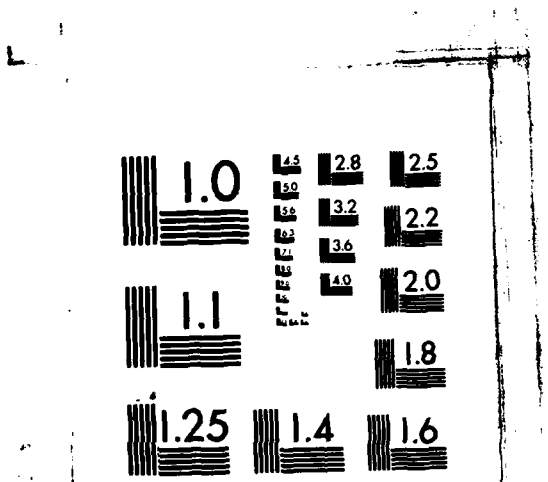
Secondary sources, such as the Souris-Red-Rainy River Basins Type II Study were also utilized. Published floodplain descriptions and acreage estimates in a Swan Creek and Buffalo Creek Watershed application dated October 29, 1954, and the Swan-Buffalo Creek Watershed Work Plan published by the Soil Conservation Service in 1957 indicate a larger floodplain

than that derived from delineated sources in Figure II. The former cites 65,000 acres north and east of Leonard and the latter, approximately 39,000 acres in the Swan Creek-Buffalo Creek area. For this reason, additional area is shown in a cross-hatch pattern. However, owing to the age of the data, it is not known how well this reflects existing conditions.

AD-A140 692 MAPLE RIVER SUBBASIN RED RIVER OF THE NORTH RECONNAISSANCE REPORT(U) GULF SOUTH RESEARCH INST BATON ROUGE LA DEC 80 DACW37-80-C-0017 2/2

UNCLASSIFIED F/G 8/8 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Appendix B
INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) MAPLE RIVER SUBBASIN

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS) MAPLE RIVER SUBBASIN

Number	Name	Administration	Location	Acres	Campgrounds[2]	Playground	Athletic Field[3]	Golf Courses[4]	Boat Ramps	Picnic Tables	Beach	Pool	Trails[5]
[1]	Koldok WMA		Barnes Co. 14056W15 Koldok	214.0									
[2]	Magnolia WMA	State	Cass Co. 14054W25 Magnolia	103.0									
△1	Casselton Park	Municipal	Cass Co. Casselton	4.0									
△2	Mapleton Park	Municipal	Cass Co. Mapleton	102.0			1	9					
(1)	Casselton Golf Course	County	Cass Co. Casselton	35.0				9					
(2)	Enderlin Parks and Golf Course	Municipal	Ransom Co. Enderlin	62.0	20		3	9	1	25		1	
(3)	Leonard Golf Course	Private	Cass Co. Leonard	120.0				9					

[1] Facilities included are those with 15 or more acres.

[2] Number of campsites.

[3] Number of fields.

[4] Number of holes.

[5] Number of miles.

Source: North Dakota State Parks and Recreation Department, Inventory of North Dakota Outdoor Recreation Facilities, 1979.

Gulf South Research Institute.

Appendix C
COMMENTS

Appendix C
COMMENTS

The purpose of this subbasin report was to provide an overview of the water and related resource problems and needs and to assess potential solutions. Toward this end, draft copies of this report were circulated to Federal, State, and local agencies and comments were sought.

This review resulted in complete and factual documentation. Thus, the study should serve as a building block for the timely completion of future water resource efforts within the subbasin. Further cooperative efforts are, however, needed to evaluate these tentative results and to develop potential solutions.

A distribution list and copies of the comments made with respect to the draft report are included as part of this appendix. Comments that resulted in specific modifications to the draft text are marked by an asterisk.

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

NCSED-PB

20 November 1980

Mr. Mike Liffmann
Project Manager
Gulf South Research Institute
8000 GSRI Avenue
Baton Rouge, Louisiana 70808

Dear Mr. Liffmann:

The draft Maple River subbasin report was distributed for review and comment. Interagency comments will be provided as soon as they are received.

a. Inclosure 1 is the general office comments that need to be considered when preparing the final Maple River subbasin report and the remaining subbasin reports.

b. Inclosure 2 identifies specific office concerns that are applicable to the Maple River subbasin.

If you have any questions on our comments or proposed modifications, please contact us.

Sincerely,

Louis Kowalski

LOUIS KOWALSKI
Chief, Planning Branch
Engineering Division

2 Incl
As stated

United States Department of the Interior
FISH AND WILDLIFE SERVICE
AREA OFFICE—NORTH DAKOTA
1500 CAPITOL AVENUE
P.O. BOX 1897
BISMARCK, NORTH DAKOTA 58501

NOV 1 8 1980

Colonel William W. Badger, District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Re: Red River Mainstem (CE)

Dear Colonel Badger:

This letter provides U.S. Fish and Wildlife Service (FWS) comments on the Draft Reconnaissance Report recently compiled by the Gulf South Research Institute for the Maple River Subbasin in Steele, Barnes, Cass, Ransom and Richland Counties, North Dakota.

As expressed in our comments on previous subbasin reports, our major concerns are associated with the woodland, grassland, wetland, riverine and riparian flood-plain habitats that still remain within this subbasin. Much of the woodland, grassland and wetland habitat in the eastern half of the subbasin has been converted to agricultural use. We agree with the statements on pages 10, 24 and 33 that these remaining grassland, woodland and wetland habitat types are significant and need to be protected, conserved and enhanced within the subbasin.

The report addressed six structural alternative measures that have been identified to date to meet the study's flood damage reduction objective. The report indicated, however, that only two of these measures have a favorable B/C ratio and appear to be economically feasible. These measures and our comments relative to each are as follows:

Alternative 1 - Upstream Reservoir and Channel Improvements

This alternative consists of a flood control reservoir north of Enderlin and channelization of approximately 64 miles of the Upper Maple River to contain the 10 percent (10 year) flood. The reservoir would have 47,000 acre-feet of flood storage capacity. The capacity of this reservoir could be increased somewhat to provide for multipurpose use. The combination reservoir and channelization would provide about 7.5 percent (13.3 year) flood protection for the Maple River Subbasin and would protect 5,600 acres of cropland in the 1 percent (100 year) flood plain. This alternative does not have benefits that exceed costs. If this alternative is implemented, adverse environmental impacts will be severe.

Alternative 2 - Channel Modification (10 Percent Flood)

This alternative consists of channelization of the Upper Maple River and Mainstem Maple River channels to contain the 10 percent (10 year) flood. This measure includes 64 miles of channelization along the Upper Maple River in

Alternative 1, and 70 miles of channelization along the Mainstem from the Upper Maple to the Sheyenne River. This measure would provide 10 percent flood protection for the Maple River Subbasin. This alternative would protect about 4,600 acres in the 1 percent flood plain.

In our view, channelization projects constitute short-term, piecemeal and localized attempts to reduce flooding problems that disregard effective long-range solutions and place an added burden of flood waters on people and property downstream. It is the FWS's belief that wetland drainage, both legal and illegal, is one of the principal causes for the increased frequency of flooding in the Red River Basin to date. In the past, stream modification alternatives in the Prairie Pothole Region of North Dakota and western Minnesota facilitated the drainage of existing wetlands, in addition to those already drained in the project area. This alternative does not have benefits that exceed costs. If this alternative is implemented, adverse environmental impacts will be severe.

Alternative 3 - Clearing and Snagging

This alternative consists of clearing and snagging the Upper Maple River and Mainstem Maple River to provide 30 percent (3.3 year) flood protection. This measure covers the same channel reach as Alternative 2. This alternative would provide 30 percent flood protection for the Maple River Subbasin and protect 2,000 acres in the 1 percent flood plain. Clearing and snagging can have impacts ranging from slight to severe on fish and wildlife habitat, depending on the amount and type of vegetation and obstacles removed and the methods used to remove them.

Alternative 4 - Agricultural Levees

This alternative consists of constructing 25 miles of agricultural levees along each side of the Maple River Mainstem channel and 7 miles each along the channels of the Swan and Buffalo Creeks, all to high ground. This measure provides 1 percent flood-plain protection for the Maple River Subbasin and protect 15,000 acres in the 1 percent flood plain, which would have a maximum width of about 6,500 feet near its junction with the Sheyenne River and would narrow to about 800 feet at its upstream termination.

Our main concern with this alternative is that the levees be constructed outside the riparian woodland corridor to minimize adverse impacts on riparian woodland, wetland and grassland habitats. Page 62 of the report states that moderate to maximum beneficial effects are anticipated for wildlife resources, since the large setback would induce development of a riparian community (woodland and/or brushland habitat) between the levees in these areas. We suspect, in many instances, this would only occur if these areas are "zoned" to prevent agricultural activities from being undertaken between the levees and existing river channel. It is also stated on page 62, that minimum beneficial recreation benefits would occur from fishing activities in borrow areas that would be created in order to construct the levees. We concur with this statement. Instead, we would suggest that wetland areas be constructed in these borrow site locations as a mitigation feature for the project. The

general design specifications for these wetland areas, however, should be correlated with the FWS. This alternative does not have benefits that exceed costs. If this alternative is implemented, adverse environmental impacts will range from moderate to severe depending on the placement of agricultural levees.

Alternative 5 - Urban Levees

This alternative would provide protection for Enderlin and Mapleton against the 1 percent (100 year) frequency flood. This alternative does not have benefits that exceed costs. Environmental impacts of the local protection facility contemplated for Enderlin and Mapleton are likely to be minor, especially if levees are placed outside wooded areas.

Alternative 6 - Farmstead Levees

We do not anticipate any adverse environmental impacts due to this alternative providing the dikes are not constructed through wetland areas and impacts to existing woodland vegetation are avoided to the extent possible.

Generally, we believe the draft report to be well written and it provides a good overview of the water related land resources, problems and possible solutions to some of these problems within this subbasin of the Red River of the North. We suggest, however, that the following changes be made in the report:

*1. Page 24, second paragraph, fourth sentence - We suggest this sentence be changed to read, "Common furbearers are the red fox, raccoon, skunk, muskrat, beaver and mink".

*2. Page 35, first paragraph, under the heading "Waterfowl Production Areas" - We suggest this paragraph be changed to read as follows:

> "Waterfowl Production Areas (WPA's) are wetland areas that the U.S. Fish and Wildlife Service (FWS) has either acquired through fee title, or obtained an easement interest in, to preserve valuable breeding, nesting and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of migratory bird hunting and conservation stamps (Duck Stamps). These WPA's are signficant because they provide the public with a great variety of wildlife-oriented recreational oppotunities, as well as providing valuable habitat for migratory waterfowl and many other forms of wildlife. FWS is responsible for the compatibility determinations (uses) and the issuance and denial of permits involving these lands. WPA's acquired in fee title are managed for optimum wildlife production, particularly waterfowl. On easement WPA's, the rights acquired are limited to the burning, draining and filling of wetland basins and right of access. All other property rights remain with the

landowners. The approximate locations of the WPA's acquired in fee within the subbasin are shown in Figure IV. Total acreage of these WPA's, fee and easement, included in the subbasin are listed in Table 10."

*3. Page 36, Figure IV - Place "fee tracts" in parenthesis after the legend. We believe at least 20 WPA's should be identified by a dot in Figure IV. We have attached a copy of Figure IV indicating the approximate locations of these WPA's (Attachment 1).

*4. Page 38, first paragraph, first sentence, under the heading "Rare and Unique Plants" - Remove "(no date)" and insert "(1976)".

*5. Page 49, first sentence - We suggest the following sentences be added to this paragraph: Additional Nonstructural Alternative Study Recommendations have been included in Section XI on pages 65-66 of this report. In particular, Study Recommendation Nos. 7, 8, 11 and 13 should be totally explored to reduce flooding throughout the Maple River Subbasin.

*6. Page 62, first paragraph last sentence - We suggest that this sentence be omitted from the report. It is doubtful, at best, to conclude that water quality will be appreciably improved after the channelization of 134 miles of the Maple River. In the view of the FWS, water quality will be further degraded over the short and longrun scenarios resulting from this structural alternative.

7. Page 64, third paragraph, under the heading "Evaluation" - It is doubtful that riparian woodlands would expand, be created or be protected unless strict "zonation" be implemented and enforced.

*8. Page 65 - Add "riparian woodlands" to Recommendation No. 2.

*9. Page 67, Bibliography Citation No. 1 should read as follows:

Barker, William T., Gary Larson and Richard Williams. 1976. "Rare and Unique Plants of North Dakota". Department of Biology, Agricultural Experiment Station, North Dakota State University, Fargo, North Dakota.

*10. Page 71, Bibliography Citation No. 1 should read as follows:

U.S. Fish and Wildlife Service. 1978. "Terrestrial and Aquatic Resources Package for North Dakota Tributaries to the Red River of the North". Area Office, Bismarck, North Dakota.

*11. Page 71, Bibliography Citation No. 2 should read as follows:

_____. 1980. "Terrestrial Resources Package for Minnesota Tributaries to the Red River of the North". Ecological Services Office, St. Paul, Minnesota.

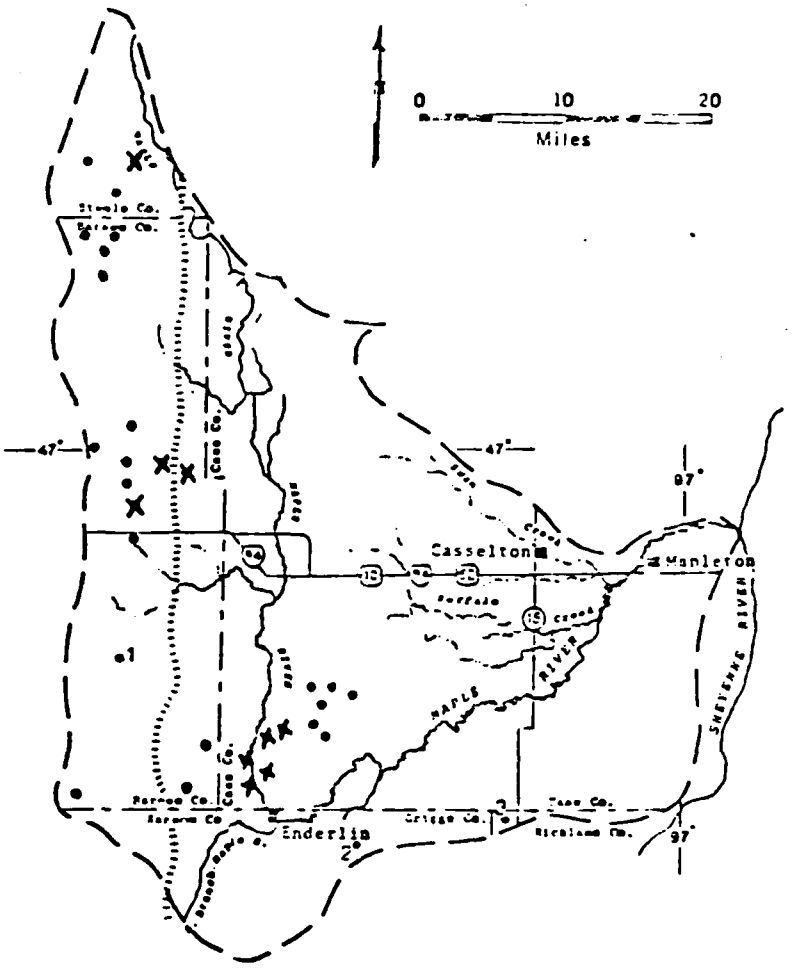
These comments have been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and other authorities mandating Department of the Interior concern for environmental values. They are also consistent with the intent of the National Environmental Policy Act of 1969.

The opportunity to review and comment on the Draft Reconnaissance Report of the Maple River Subbasin is appreciated.

Sincerely yours,

for Gilbert E. Key
Area Manager

Attachment (1)



- NATURAL AND SCIENTIFIC AREAS
  - 1 Cuba Marsh
  - 2 Marshland
  - 3 Piper Sandhills
- WATERFOWL PRODUCTION AREAS (Fee Tracts)

*Exact locations and numbers of waterfowl production areas are on file at the U.S. Fish and Wildlife Service, Area Office, Bismark. No copies of these maps have been published or released but can be reviewed at the above office.

Source: State Comprehensive Outdoor Recreation Plan, 1975; Kantrud, 1973; USFWS, 1980.

Figure IV. WATERFOWL PRODUCTION AREAS AND SCIENTIFIC AND NATURAL AREAS

NORTH DAKOTA
STATE WATER COMMISSION
bismarck 58505
north dakota

December 10, 1980

Col. William W. Badger, District Engineer
St. Paul District Corps of Engineers
1135 U.S. Post Office & Customhouse
St. Paul, MN 55101

RE: Red River Mainstem Study - SWC Project #1701

Dear Col. Badger:

This letter is to provide comments on the draft reports for the Maple River Subbasin, Wild Rice River Subbasin, and Mainstem Subbasin for the Red River of the North Reconnaissance Study.

In the Maple River Subbasin Report, the implication is made that the only forms of valuable recreational resource are large bodies of water and forest tracks. This is not true, since even within the Maple River Basin there are areas suitable for canoeing and hiking which are considered valuable by some. Other forms of limited recreation do exist, as is mentioned in the report. The section on water quality problems should be quantified if possible. Use of such terms as "excessive", "insufficient", and "exceeds", can be very deceiving when not quantified. Quantified soil loss figures should be available from the Soil Conservation Service. These figures could be used to quantify the erosion problems. The North Dakota State Health Department should be contacted to determine whether or not improved waste water treatment facilities are planned for the communities within the subbasin.

Under the section titled "Public Perception of Problems and Solutions", mention should be made that there are county water management boards which have been organized for years. These boards could help in providing information for this section. Credit should also be given to the Soil Conservation Service in this section for their involvement in the watershed planning or P.L. 566 Program. In the "Transportation Network" section, a statement should be made as to the condition of the transporation system within the subbasin, excluding the major state and federal highways. Throughout the report, reference is made to ground wells. The word "ground" should be deleted from this phrase, since ground and well are redundant in this instance. The section entitled "Aesthetics"

should be deleted from the report. Since aesthetically appealing views are not defined in the report, they may mean different things to different people. For those people living within the subbasin, the existing landforms although featureless, may be very appealing to them.

On page 33, reference is made to the "Cernhous Report". Since this report is not thoroughly documented, nor is complete evidence available to support all of the findings of the report, reference should not be made to it. Also on that page, the section addressing the number of wetland acres remaining in the subbasin should be deleted. The method used to expand the 1964 survey may not be very scientific since the 1964 survey may have not been a random sample. Also, the section is very confusing since the information appears to pertain only to 1964 data, and it would be impossible to update this to 1980 data. In the "Waterfowl Production Area" section, the implication is given that all easement areas that are obtained through the wetland easement program are considered to be waterfowl production areas. This is not true, since generally Waterfowl Production Areas are only those areas owned in fee title by the U.S. Fish and Wildlife Service.

In the section entitled "Threatened and Endangered Species", mention should be made as to when the black-nose shiner was actually last recorded in the Maple River. Under "Other Important Species", mention should also be made as to when the three species mentioned were last verified within the subbasin. In the "Rare and Unique Plants" section, were the 12 species listed actually recorded within the Maple River Subbasin, or were they just recorded within those counties?

* On page 45, mention is made of seven state agencies which are involved directly in water and related land resources planning. These seven agencies should be listed. Also on that page, in the final paragraph, mention should be made of the state agencies, such as the State Water Commission, which should be consulted in devising flood control measures for the subbasin. Again on page 48, reference is made to the "Cernhous Report". As mentioned before, this reference should not be made. Further in that paragraph, reference is made to a statistical study, not being familiar with this study, I do not believe that it could be applicable to the watersheds within North Dakota. Because of the characteristics of watersheds within North Dakota, it would be impossible to realize a 75-80% reduction in flood peaks if only 30% of the watershed was in wetlands. This would almost imply that there was virtually no runoff from the remaining 70% of the watershed.

In the chapter entitled "Formulation of Alternative Measures", a recommendation is made to construct agricultural levees along the Maple River. The basis for the spacing of these levees should be mentioned. At a minimum, the spacing should be such that the levees would comply

with criteria now in existence for the Red River, which does not allow for more than a six inch increase on the 100 year flood. In the chapter entitled "Assessment of Alternatives", the nonstructural measures should be mentioned and an estimate of the economic impact made.

In the Wild Rice River Subbasin Report, the statement is made that floods within the subbasin are almost an annual event. This statement should not be made unless it can be quantified and shown that floods do occur that frequently. The statement does imply that this frequent flooding causes damage. In some recent situations, flooding may occur but there may not be damage associated with it. In the section on "Waste Water Management", the statement is made that releases from inadequate treatment systems have severely degraded the river's water quality. The reference for this statement does not have a date; it is possible that since this reference was published that the communities within the basin have improved their waste water management systems. If this is true, that statement may not apply to existing conditions. On page 16, the statement is made that no watershed districts exist in the Wild Rice River basin. This is not true since there are water management boards within each county within the subbasin. On page 36, reference is made to a "high" table. This should be corrected to read "high ground-water" table.

The same comments which were made on the "Wetlands" section of the Maple River Subbasin Report would apply to the "Wetlands" section of the Wild Rice River Subbasin Report. The expansion of the 1964 data would not be accurate, and would not apply to today's conditions. On page 51, the State Water Commission should be listed as an agency to be consulted in future flood control planning. On page 54, reference is again made to the "Cernhous Report", which should be deleted. In that same paragraph, the same statistical studies as were referenced in the Maple River Subbasin Report are used. The same comment made regarding the Maple River Subbasin Report would apply here. In the "Assessment of Alternatives" chapter, a discussion should be made regarding nonstructural measures. The economic assessment of Alternative 1, Channel Improvements to 44 Miles of Antelope Creek, should be looked at more closely since the benefit/cost ratio comes very close to approaching unity. By using estimates from reports pertaining to other subbasins, it's very possible that there may be slight variations in the subbasins which could cause benefits to be slightly greater, thus this alternative should be carried forth to the "Evaluation" chapter.

In the Mainstem Subbasin Report, greater emphasis should be placed on the water supply problems being experienced by the City of Fargo. In 1977, Fargo had to import water from the Sheyenne River Basin to meet its water supply demands. In the"Public Perception of Problems and Solutions" section, mention should be made of the informal agreement

between the Lower Red River Watershed District and the Red River Joint Water Management Board. This informal agreement calls for cooperation between these two entities in attempting to manage the water of the Red River Basin.

On pages 49 and 51, reference is again made to the 1964 Inventory of Wetlands. For the same reasons as mentioned earlier, reference to this particular inventory should be deleted. In the comparison made between the 1964 and the 1974 inventory within the Minnesota counties, it can be seen that expanding the 1964 data by multiple of four does not yield accurate estimates for a 100% survey.

On Table 13, pages 56 and 57, a column should be added to show the most recent date of a confirmed siting of the threatened or endangered species. A similar column should be added to Table 14, for rare and unique plants.

On page 67, reference should be made to the two large water management entities which have authority within the Mainstem. These include the Lower Red River Watershed Board in Minnesota and the Red River Joint Water Management Board in North Dakota. On page 73, the statement is made that agricultural levees on the Mainstem have been instrumental in preventing agricultural losses. The quantified basis for this statement should be included. The statement should go on to say that the same agricultural levees have been instrumental in aggravating agricultural losses in unprotected areas.

On page 76, the structural measure addressing agricultural levees should state that the levees would be constructed in compliance with the existing criteria and agreement between the states of North Dakota and Minnesota. This same statement should be added to the last paragraph on page 89, and also to the first paragraph on page 91. On page 91, separate benefit/cost ratios should be listed for each of the reservoirs included in Alternative 5.

Overall, all three reports contained much valuable information. It does appear as though these reports make a greater attempt at identifying water management problems which exist throughout the basins, and are not totally restrictive to flood control problems. This is an improvement over previous reports.

Sincerely,

Cary Backstrand
for

David A. Sprynczynatyk, P.E.
Director of Engineering

DAS:sh

GENERAL COMMENTS
DRAFT MAPLE RIVER SUBBASIN REPORT
(OCT 1980)

(These comments apply to the entire report and all subsequent subbasin documents.)

1. Comments from Federal, State, and local agencies and a letter from the St. Paul District will be included in an appendix in each final subbasin and in the overall report. The format for the appendix will be:

a. Introduction - This section should stress:

(1) The importance of completing the study on time.

(2) That the purpose of the study is to advise other agencies and interests.

(3) The need for a selected review by various interests to provide complete and factual documentation.

(4) The use of the study as a building block for future water resource efforts.

(5) That cooperative efforts to evaluate results and develop solutions to remaining problems will be incorporated.

(6) A complete public involvement program when the study is finished.

b. The distribution list.

c. Copies of letters of comment.

Only comments that identify significant errors or need specific attention will be addressed in the final subbasin report. However, all comments incorporated should be identified with a marking system. The distribution list similar to that previously provided in other subbasin comments should be used.

2. Care should be taken to ensure that similar data reported in the various draft reports are uniform, consistent, and accurate. For example, in the climate sections temperatures are recorded in ranges, means, and averages. Also, many of the data identified are presented in far too much accuracy than is possible. This creates a false impression of the availability of data.

3. The supporting information for alternatives including technical, economic, and environmental backup data should be provided (at least under separate cover).

Incl 1

4. All references by the same author and of the same year should be ranked (i.e., 1979a, 1979b, etc.) so that these references can be distinguished.

5. The evaluation section of each report is primarily the recommendations of the document. Generally only the alternatives which have a benefit-cost ratio greater than 1 are presented. Little attention is given to other less economically feasible alternatives that may be important in specific aspects of future flood damage reduction planning for the subbasin as well as the basin as a whole. Some of these alternatives may provide the necessary environmental or social conditions to warrant future attention. Therefore, this section should be expanded to provide the appropriate discussions.

6. The 1980 current normalized prices issued in October 1979 were revised in July 1980. A table showing the revised 1980 current normalized prices for principal commodities has been provided previously and should be used. All references to current normalized prices should be labeled as "prerevision" or "postrevision".

7. The lack of large lakes and sizable forest tracts combined with poor water quality in existing rivers severely limits the diversity of recreation opportunities in most subbasins. For this reason, it is extremely important that alternative flood control measures be scrutinized for their impacts on those areas that do contain large lakes, sizable forest tracts, and rivers with good water quality.

ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SPECIFIC COMMENTS
ON THE
MAPLE RIVER SUBBASIN REPORT
(OCTOBER 1980)

1. Page 6, top half of page - Note that historically Maple River floods have two peaks -- one from the area below Enderlin, and one from the area above Enderlin.

2. Page 7, Figure II - The escarpment should be identified on the map.

* 3. Page 13, Public Perception of Problems and Solutions - The reason the public perception of problems and solutions is poorly defined is not simply a lack of Corps-conducted public meetings in the area. (The Corps did conduct some public meetings for the Enderlin Flood Control Study.) It is doubtful that a couple of public meetings would have enabled adequate definition of problems and solutions. The social analysis which would yield this information is identified on page 66-A of this report as an area needing further study. A rewrite of this paragraph is suggested to reflect the Enderlin meetings and the difficulties in adequately defining public perception.

* 4. Page 15, last paragraph - Change sentence (...it is evident that residents of the Red River Basin consider flood control...) to read (...it is evident that most residents of the Red River Basin consider flood control...). The first statement implies that this opinion is shared by all the residents of the basin. It is quite probable that some residents may think other water-related problems are more important; i.e., the farmer living in an upland area who has water supply problems.

5. Page 16, paragraph 2 - Indicate the in- and out-migration as net migration.

6. Page 16, paragraph 3 - The link between Enderlin's population decrease and its disastrous floods should be explored if further study is undertaken in the subbasin.

* 7. Page 17, paragraph 2 - The term "close-knit" is inaccurate as used here. "Close-knit" implies high social integration, of which home ownership, length of residence, and county of employment are not reliable indicators. Choose a different term or provide a different basis for using "close-knit."

8. Pages 18-19, Income and Trade - What is the correction factor used to convert figures to 1979 dollars? It would be helpful if it were included.

9. Page 18, Income - The distribution of income (such as percentage of population below the poverty level, etc.) should be included, if available.

Incl 2

10. Page 18, Agriculture - In addition to the factors noted on yield per acre, harvested acres, and total production for particular crops, it would be helpful if gross income per acre for particular crops were included. This information would give a better understanding of the relative importance of each crop. One other factor that would aid understanding of flooding problems is the differential in susceptibilities of crops to flood damages. Some crops are not as seriously affected by a flood event as others. In addition, the differential in costs per acre to plant particular crops would aid understanding.

* 11. Page 21, Land Use - The percentage breakdown does not add up to 100 percent. This should be corrected. Also, the percentage of urban development appears too high. Please recheck. Finally, Mapleton should be added as a town located, at least partially, in the floodplain.

* 12. Page 29, paragraph 2 - Change "some possible reported" to "some reported possible..." in second sentence.

* 13. Page 30, paragraph 1 - Change last sentence to read: "At this time no prehistoric or historic sites in the subbasin are listed on or are eligible for inclusion on the National Register of Historic Places."

14. Page 30, Social - In addition to the information presented, a discussion of the social consequences or implications of floods, particularly those concerning behavioral damages that may occur, would be helpful.

15. Page 33, last paragraph, 4th and 5th sentences - There is an apparent conflict as to whether Type I wetland acreage can be tabulated. To clarify, we suggest identifying the reason that these types were not measured in 1964. Even if the estimate given has some basis, we request the Type I information presented in Table 9 be modified to reflect the accuracy of the data.

* 16. Page 37, Threatened and Endangered Species - Specify which species are considered threatened or endangered only by North Dakota (e.g., blacknose shiner) and which species are federally listed as threatened or endangered by the Fish and Wildlife Service (e.g., bald eagle and peregrine falcon).

17. Page 44, Without Project Conditions - This section is confusing because the Enderlin Flood Control Project and the SCS watershed project have been previously identified. It would appear that "...a plan to alter resource management programs" has already been developed at least for a portion of the subbasin.

* 18. Page 47, Figure V - The existing Corps flood control measure is incorrectly located. It was implemented only on the Maple River not the South Branch.

19. Page 49, 2nd paragraph - The three SCS reservoirs identified could significantly reduce flooding in the Swan-Buffalo Creek watersheds and even along the lower Maple River; however, it is doubtful if their impact could be as great as 1,000 cfs at the Red River. This should be rechecked for accuracy.

20. Page 50, Planning Objectives - The second paragraph seems to be too strongly stated. The following rewrite is suggested:

* The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information that was available. On the basis of this analysis of the problems, needs, and desires that could be identified, the following planning objectives were established.

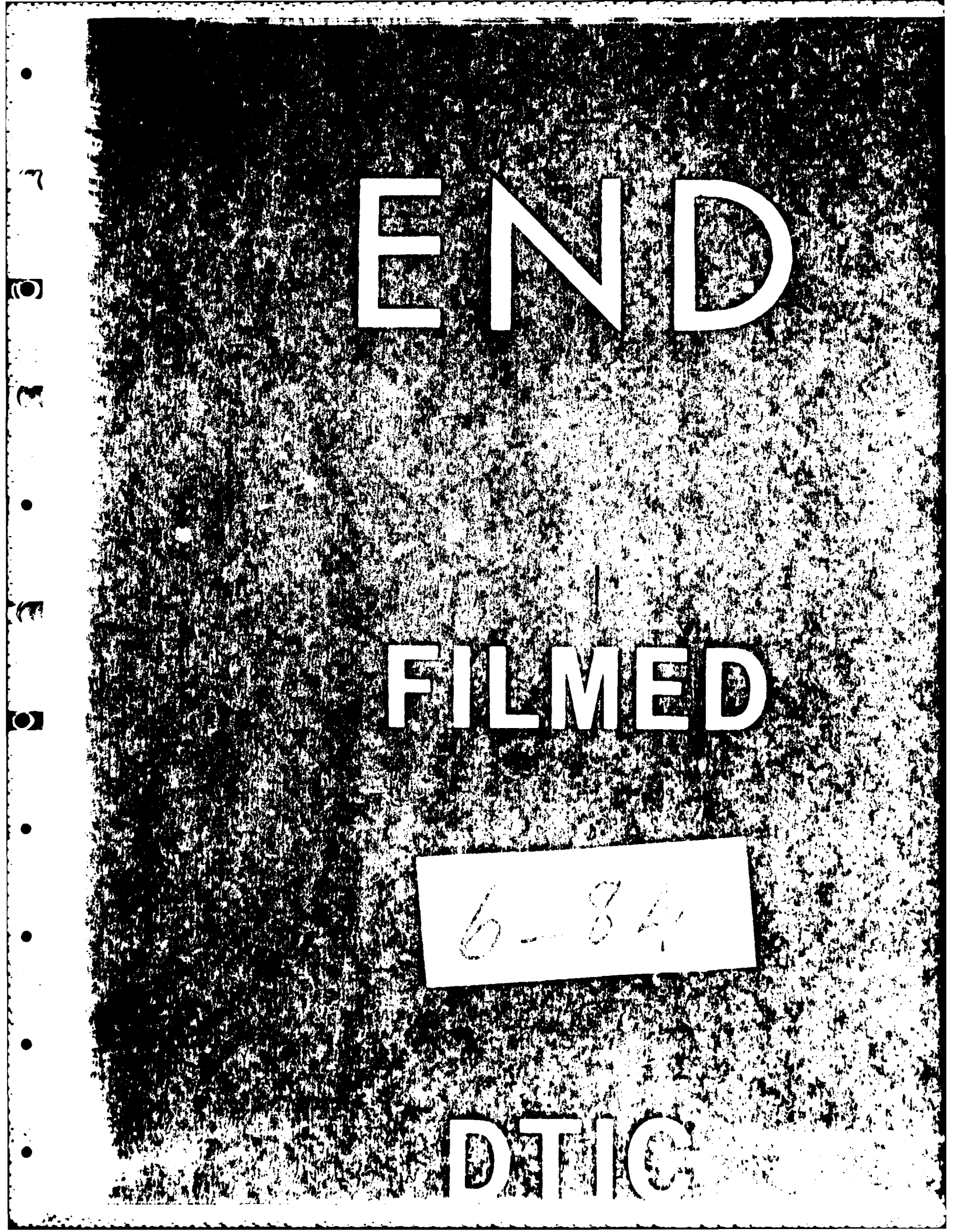
21. Pages 58-63 - The references made to borrow pits and channelization impacts on existing and potential recreation opportunities in the assessment of alternatives section need clarification. Channel modifications and/or diversions not only alter the natural appearance of waterways. In many instances, they also destroy existing vegetation and fish habitat that originally attracted recreationists. The resulting net benefits to recreationists many times turn out to be less than were available in the first place. In addition, the borrow pits created during levee construction could not be used to a significant degree by recreationists in this area.

* 22. Page 60, Channel Improvements - The assumption that water quality would improve in the long run as a result of channelization is not valid. In fact, page 25 states that previous channel improvements have contributed to the degradation of water quality in the subbasin. The references to increased water quality as a result of channelization should be deleted.

23. Page 62, Agricultural Levees - In most cases, it is not reasonable to assume that existing habitats will be improved or that new habitats will be created riverward of the agricultural levees. Farmers will continue to farm this land whenever possible. At best, adverse or beneficial impacts will be negligible.

* 24. Page 66, Additional Study Needs - No. 23 is submersed under number 24. Suggest they be combined to read: "A detailed institutional analysis of the subbasin is needed. Part of this analysis would be a detailed study of the objectives, goals, and programs of the many institutional entities involved in water resources planning. This study, particularly at the local level, is needed to determine the most efficient institutional approach to the resolution of flooding problems."

25. Page 66, Additional Study Needs - It should be noted in each subbasin report that the probability of institutional and social boundaries being the same as subbasin boundaries is remote, at best. Since this boundary-overlap exists, integrated basin-wide social and institutional analyses are desirable.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